

INTERNATIONAL INSTITUTE OF AGRICULTURE
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

INTERNATIONAL REVIEW OF THE SCIENCE
AND PRACTICE OF AGRICULTURE

MONTHLY BULLETIN
OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

FIRST PART.
ORIGINAL ARTICLES

The Live Stock Industry in Australia.

by

W. A. N. ROBERTSON, B. V. Sc.

*Chief Veterinary Officer, Live Stock Division,
Department of Agriculture, Victoria, Australia.*

In dealing with the Live Stock Industry in Australia it is necessary, in the first place, to draw attention to a few geographical details in order that readers may be familiar with the diverse conditions of soil and climate met with. The Continent has been settled for only a little over 100 years. It has an area of 2 974 581 square miles, being approximately three-fourths as large as Europe; 14 times as large as France; 24 times as large as the United Kingdom of Great Britain, and 26 times as large as Italy. It is situated between the 12th and 40th degrees of South Longitude. This will give some idea of the vast area, the great distances and the variation of climate and herbage met with. The influence of such varying conditions upon the Live Stock Industry will be readily recognised.

1. — THE HORSE. — In the early days of colonization the horse required was one capable of carrying his rider for long distances over all classes of country, either for a journey — 60 to 100 miles a day was lightly thought of — or for rounding up and mustering cattle in the enclosed areas of scrub and timber land or undulating plain. The qualities required for this work were stamina, speed, and agility. These were found in the English Thoroughbred and there quickly developed, in the rising generation, a love for racing and an inherent love for the horse. As time passed, and Settlement advanced, it became necessary to introduce the draught horse, crosses with the Thoroughbred were obtained and the light horse industry divided into two channels.

As Settlement of the country proceeded along the sea board and railways were laid down, the necessity for long journeys in these areas diminished, and the love of racing progressed. The Thoroughbred came under control

of a Stud Book and has developed along such lines until his reputation is known the world over. The other channel produced a thicker set and heavier horse from the various crossings which had taken place and a type was evolved which held its own against the product of other lands for military purposes. A large export trade in remounts was established particularly with India. *The love of racing, the extension of race meetings, and the desire of almost every owner (and nearly every boy owned at least a pony) to breed a winner for the local events now acted adversely upon the Industry. Horses not speedy enough, nor of sufficient stamina for classic events, were used on ponies and rejected remounts, and a somewhat light nondescript horse was bred which became a drug on the market and remount buyers had to travel further and further back into the country, remote from railways, to find the type required.

Of recent years more attention has been devoted to the breeding of this remount type of horse and for this the big boned thoroughbred is used. Light horse breeding, as distinct from the thoroughbred for classic races, has been pushed back into the sparsely populated interior of the country as settlement extended and the land became more valuable for other purposes. At this time the Government examination of stallions, referred to later, was introduced, and efforts were made to swing the pendulum back to remount breeding. A Conference of representatives from all parts of Australia, which recently met in Melbourne, made recommendations which are summarised below:—

That the first step to be taken was the elimination of unsuitable stallions and provision of suitable ones to stand at a reasonable fee.

That Mares suitable for breeding remounts be registered under district Committees and would advise as to matings, etc., and that fees for carrying on the work be obtained by tax on the Totalizator.

The Conference was of opinion that in any scheme for improvement the Thoroughbred Stallion was essential and the right type should be encouraged by providing more valuable stakes to be run for. Further, that Mares not suitable for breeding horses could be profitably used for Mule breeding.

Importations of Arabs and various classes of ponies have been made from time to time and all have left their representatives which have had an influence to a greater or lesser degree upon the Industry.

The future holds great possibilities. There are vast tracts of country still unused which are admirably adapted for horse breeding on an extensive scale.

THE DRAUGHT HORSE INDUSTRY. — During the early days of settlement horses of medium weight were found suitable for the limited amount of cultivation carried on, but as this extended it became necessary to develop a more weighty animal and many importations of the Scottish Clydesdale Stallion were made. As the export trade in wheat developed and large areas were thrown open to cultivation, weight was required to pull the 3, 4, and 5 furrow plough, over the hundreds of acres each farmer worked and to cart the produce over bad roads to the railways. Two classes of fanciers arose, one favouring the Clydesdale, the other the heavier Shire Horse. Many importations were made but no Stud Books

ere in use and the breeds became mixed and the individuality of the respective types somewhat lost.

Then a school of breeders arose who considered the horse with the right of the Shire and the activity of the Clydesdale was the one required and an attempt was made to evolve an Australian draught horse. Prizes at the various Shows were given for draught horses, and Clydesdales and Shires competed in the same ring. This led to some confusion and resulted in an educational campaign being undertaken by the respective Governments with the object of impressing upon breeders that whilst the cross between the two breeds might be best for utility purposes, it could only be obtained by keeping the two parent types distinct and pure. Gradually the larger Agricultural Societies took the matter up and at their shows separated the two classes and the Clydesdale and Shire are now shown separately. The former is the more popular horse and Stud Books are now in operation in the Southern States of New South Wales and Victoria, while the system is extending to the other less settled ones.

METHODS OF IMPROVEMENT. — The most noteworthy method of improvement of the Industry that has been adopted by the Governments of Australia is that which is referred to as the Government certification of Stallions. For the successful understanding of the scheme it is necessary to know that the Governments grant a subsidy to Agricultural Societies throughout the States to assist them in the holding of annual Shows. In 1907 the State of Victoria introduced a system of issuing a Certificate to any stallion which, on being submitted to examination by a Government Veterinary Officer, was found to be free from hereditary unsoundness and to be of suitable breed, type and conformation to be approved as a sire. The following year it was decided that any Society desirous of obtaining the subsidy should arrange that no prize was to be awarded to any Stallion three years old or over unless he held the Certificate. The scheme was readily adopted by breeders and within a few years extended to the other States of the Commonwealth. At the present time all States are in unison on this subject. The result of the examination for the past ten years, so far as the State of Victoria is concerned, is set forth in the accompanying Table.

An examination of the Table shows that the percentage rejections on account of unsoundness over the ten years have been as follows : —

1907/8,	1908/9,	1909/10,	1910/11,	1911/12,	1912/13,	1913/14,	1914/15,	1915/16,	1916/17
15.04	17.17	15.04	17.09	10.12	11.59	10.58	13.76	14.93	11.25

At first sight this does not appear encouraging, but closer investigation shows that the unsoundness in light horses and ponies is slight, while the inclusion of these classes in the totals and the varying numbers submitted makes considerable changes in the ratio of unsoundness. A far better index of the value of the examination is to take only that breed in which unsoundness is prevalent, namely the draughts, and for the past ten years the figures run : —

1907/8,	1908/9,	1909/10,	1910/11,	1911/12,	1912/13,	1913/14,	1914/15,	1915/16,	1916/17
23.82	27.33	23.52	21.57	12.13	12.03	11.0	15.5	19.67	16.49

By dividing this period into two of five years each and so eliminating the seasonal fluctuations, we see that for the 1st quinquennial period an average of 20.8 per cent. was rejected, while in the 2nd period the percentage was only 13.4 or a difference of 7.4 per cent and a decrease of 35 per cent.

When it is realized that certain horses though pronounced unsound have not been discarded from breeding operations altogether and that, therefore, many of their progeny are still coming forward, this result can only be regarded as satisfactory.

A Bill has now been drafted to provide for the registration of Stallions and it is hoped that it will shortly be placed upon the Statute Book. When the measure becomes law no person will be permitted to use a stallion for breeding purposes unless the same is registered and only those which obtain a Certificate, issued by a Government Veterinary Surgeon, will be eligible for such registration. Examinations will be conducted on similar lines to those in existence at present. Parades are arranged and a Veterinary Officer is in attendance to conduct the examination. He determines two things:

1) Is the animal free from Hereditary Unsoundness, and for this purpose the following diseases are scheduled.

Bog Spavin,	Ringbone,
Bone Spavin,	Roaring,
Cataract,	Sidebone.
Chorea, "Shivering" or "Nervy",	Stringhalt.
Curb,	Thoroughpin.
Navicular disease,	Whistling.
Nasal disease (Osteo-porosis).	

2) Is the animal of suitable type. Inferior and common bred animals are refused a Certificate.

Should an owner feel aggrieved at the decision of the Veterinary Officer, he may appeal against the rejection on either ground by lodging a deposit of £ 5 (to prevent frivolous appeals) and a Certificate from a Veterinary Surgeon or three Judges of repute, according to the ground for rejection, to the effect that the decision was against the evidence. A Board of Appeal is then appointed consisting of the Chief Veterinary Officer and two practising Veterinary Surgeons, or the Chief Veterinary Officer and two Judges, according to grounds of rejection, who examine and determine the case. If the Appeal is upheld the deposit is refunded, if dismissed the deposit is forfeited.

It is a peculiar fact that our genial climate has been instrumental in no small degree in producing a loss of weight in our draught horse. The reason for this is that when weaned the majority of breeders leave the foals running on natural pasture. When a cold or wet spell of weather occurs the young animals receive a set back, whereas in a more rigorous climate it would be imperative to house the young stock and hand feed them over such periods and keep them growing all the time. By educational lectures delivered throughout the country the breeders are becoming more conversant with the necessity to eliminate this factor and feeding and housing are receiving more attention. When properly managed, it

is universally admitted that there is no finer country for horse breeding operations than Australia.

The Suffolk Punch breed is one which has a few representatives in our Northern States but is not a popular breed. There have been small importations of other breeds such as Percherons, etc., but they have not found favour nor have there been sufficient to keep the type distinct.

STATISTICS. — As indicating the growth of the Industry from the early days, the following Table showing the number of horses in one State of the Commonwealth, for which the figures are available, viz—Victoria, will be of interest.

Year	Number	Year	Number
1836	75	1850	21 219
1838	524	1852	34 021
1840	2 372	1854	27 038
1842	4 065	1856	47 832
1844	7 076	1858	68 323
1846	11 400	1860	76 536
1848	16 495		

Similar growth occurred in other States and from 1860 the numbers in the Commonwealth are as shown hereunder.

Year	Number	Year	Number
1860	431 525	1865	1 680 419
1865	566 574	1900	1 609 654
1870	716 772	1905	1 673 805
1875	835 393	1910	2 165 866
1880	1 068 402	1912	2 408 113
1885	1 143 064	1914	2 489 000
1890	1 521 588		

Price of Horses,

Workers	£	£	
Extra Heavy Draughts	40	to	70
Medium Draughts	30	"	45
Delivery Cart	20	"	35
Order "	15	"	20
Remounts	25	"	40
Saddle & Harness	16	"	30
Horses	10	"	30

Special lines
to higher values.

STUD CLASSES.

Draught Stallions. — The price varies very considerably. Inferior classes change hands at £ 60 to £ 100, good classes at £ 300 to £ 500 which a few superior horses realize up to 1 000 guineas.

Mares range from £ 50 to £ 200 and higher.

Light Horses. — Thoroughbred Stallions suitable for use in breeding remounts range from £ 100 to £ 300, a few going to higher figures, while Mares suitable for mating vary from £ 16 to £ 30.

Thoroughbred Mares are of course higher with wide range of values according to breeding.

ASSES AND MULES. — The breeding of Mules has received very little attention, there being only 8 215 Asses and Mules in the Commonwealth.

EXPORTS. — The export trade in horses is one which has fluctuated considerably from 32 474 in 1901 to as low as 7 807 in 1909, the average being 13 700. The possibilities under this heading are enormous. There is space to breed sufficient to supply the world and the endurance of the Australian horse as shown in the theatre of war indicates that he is second to none. The distance of Australia from the thickly populated areas of Europe and the question of freights are the adverse factors.

SECOND PART
ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

197 - **Agricultural Development of British Guiana.** — SPENCE, R. O. H., in *United Empire, The Royal Colonial Institute Journal*, Vol. IX, No. 2, pp. 61-65 + Map. London, February, 1918.

DEVELOPMENT
OF
AGRICULTURE
IN DIFFERENT
COUNTRIES

British Guiana, the only British possession on the continent of South America, contains an area of 89 480 square miles, with a population of about 300 000, and produces the world-famous "Demerara Sugar" which might more correctly be designated "British Guiana Sugar".

The staple industry is really sugar, and the approximate area under areas at the end of 1916 was 75 000 acres; there is suitable land available to extend the cultivation of sugar to ten times or more the present area, and thus increase the export of sugar to over one million tons per annum. The essentials for such expansion and, indeed, for all development of any magnitude in connection with the Colony are 1) an increased labour supply, and 2) capital.

Rice cultivation now embraces about 50 000 acres and is capable of large expansion. Coconuts grow and yield well, as do also cocoa and coffee. Cotton was extensively grown when the colony was owned by the Dutch and in the early years of the British occupation, and with a plentiful supply of labour and fair prices could be again cultivated with profit. Para Rubber grows and yields well; its present area, about 5 000 acres, could be extended to a large extent as far as suitable and available land is concerned. Limes grow well wherever planted, and in properly selected areas could undoubtedly be grown at a profit. Bananas, plantains, and other ground provisions and fruits grow well, and with a proper system of cold storage and shipping facilities could be produced in quantities sufficiently large to admit of export.

Horses and cattle thrive on the coast lands, and the coastal and hinterland savannahs. There are 11 700 square miles of savannah lands suitable for stock rearing, but owing to the want of facilities for transport, the cat-

[Abstract No. 497]

tle that can be reared on 6 000 square miles of this area adjoining the Rupununi and Ireng rivers cannot be brought to market in the Colony.

British Guiana produces some of the finest timbers in the world. Those that are at present most commonly exploited are Crab wood (*Carapa* sp.) (sp. g. 0.47 to 0.7); Greenheart (*Nectandra Rodioei*) (1.06), largely used in the construction of the Manchester Ship Canal and in the construction of lock gates for the Panama Canal; Wallaba (0.98); Belata or Bullet Wood (*Mimusops globosa*) (1.00); Mora (1.06); brown and yellow Silverballi (0.77 and 0.62); Letter or snake wood (1.30); red Cedar (0.45). These woods are suitable for building purposes and the making of furniture. Wallaba and several other kinds of wood are used for fuel as a substitute for coal. The forests also abound in soft woods which are suitable for making paper pulp, yet not a single pulp-making factory exists in the Colony.

Other products are Balata, the dried latex of the Bullet tree; the exports of this gum are over 1 000 000 lbs. per annum, the bulk going to the United Kingdom; Locust gum, used in the preparation of varnishes; Tonka beans; Vanilla beans; Palm nuts of various kinds which are plentiful and could doubtless be turned to commercial value as oil producing factors; Souarri nuts, larger and finer than Brazil nuts. Plants of medicinal value also abound, of which no use whatever is now made.

498 - The Organisation of the Rural Hygiene Service in Spain. — *Boletín de Agricultura técnica y económica*, Year IX, No. 103, pp. 612-619. Madrid, July, 1917.

The Spanish Service of Rural Hygiene Inspection ("Inspección de Sanidad del Campo") was re-organised by the Royal Decree of August 8, 1916. It is as yet too early to appreciate the results obtained, but there is no doubt that great advantages will be gained by the collaboration of the new service with other technical services of the Ministry of Agriculture. The sanitary police collaborate with the agricultural engineers in many kinds of work, particularly in the improvement of malarial districts and the rational cultivation and improvement of rice and medicinal plants. The appended table gives data on malaria obtained by the District Inspectors and compares the conditions of 1915 with those of 1913. The geographical distribution of malaria in Spain, the intensity and diffusion of the disease (there is an acute summer and autumn period), the microscopical examination of the blood of malarial patients in different rural districts, and even in small villages where the disease is rampant, have been studied with the greatest care, and the present malarial conditions in each of the 14 agricultural districts of Spain has been deduced from numerous details. It should be noted that, if the number of malarial municipal centres has increased, the number of cases of sickness and of death has decreased, in spite of the increased cost of quinine and food owing to the war. This is due to the ceaseless propaganda of the sanitary inspectors in matters of hygiene. In 1917 the General Administration of the Ministry of Agriculture, Mines and Forests took steps for the encouragement by the Agricultural Stations ("Granjas agrícolas") of the cultivation of medicinal herbs and the reafforestation of marsh lands, in order to reclaim, in part at least,

741 330 acres which form the principal centres of malaria in Spain at present day.

*Malaria in Spain: Extent of Infected Districts and Loss
Caused by this Disease.*

	1913	1915
Number of municipal centres	9 261	9 261
Number of malarial municipal centres	1 428	1 492
Extent of malarial centres (1) acres	1 089 924	754 748
Present value of malarial land £	963 400	902 111
Proximate value of malarial land if reclaimed £	6 134 626	5 014 334
Number of annual cases (2)	233 494	209 420
Annual mortality (2)	2 540	2 139
Annual consumption of quinine cwt.	38.23	37.33
Value of annual consumption of quinine (3) £	42 862	83 032
Days of work lost through malaria (15 per case)	3 515 595	3 141 300
Value of days lost (at 1 s. 7d. a day) £	293 192	249 098
Value of lives lost (at £198 each) £	515 435	819 644
Total annual losses to the nation through malaria (4) £	5 347 806	4 771 472

(1) Not including the centres formed by badly cultivated rice fields and badly kept banks, rivers and canals. — (2) Figures for the years 1913 and 1915. — (3) Valued at 43¼ d a gram in 1913 and 9½ d a gram in 1915. — (4) These figures represent the total of differences between the present value of malarial land and the value such land would fetch if reclaimed; the value of quinine; the value of days lost; the value of lives lost.

In the budgets of 1915 and 1916, £29 740 were allotted to the distribution of water to rural centres. This has resulted in a considerable decrease in the number of cases of disease and death through infection by water. In Spain the water problem is usually limited to the protection and canalisation of local water, rather than to obtaining it from a distance, for most districts have a good supply of drinking water.

— **Public Health Studies Concerning Cheese.** — SCHROEDER, E. C. and BRETT, G. W., in the *Journal of the American Veterinary Medical Association*, Vol. LII, No. 6, pp. 672-685, Ithaca, N. Y., February, 1918.

The primary and special purposes of these studies on cheese were to determine the frequency with which it is contaminated with virulent tubercle bacilli at the time it reaches the consumer.

The number of samples of cheese in these investigations on which the results are now complete is 256, and among these 19, or 7.42%, were found to be infected with virulent tubercle bacilli. The bacilli in all cases were of the bovine type.

Leaving the samples of cheese of the varieties that require some time to ripen before they are marketed out of consideration, none of which were found to be contaminated with tubercle bacilli, the 194 samples of fresh cheese may be divided as follows: —

- 131 samples of cream, 18, or 13 $\frac{3}{4}$ %, infected with tubercle bacilli
 31 samples of cottage, 1, or 3 $\frac{1}{4}$ % infected with tubercle bacilli
 32 samples of Neufchatel, all free from infection.

These studies seem to warrant the following conclusions: --

- 1) that cheese of the kind which requires some time to ripen and ever contains true, living, pathogenic bacteria when it is marketed; it does not seem likely that such cheese is apt to contain dangerous products of bacterial origin;
- 2) that cream cheese is often heavily contaminated with tubercle bacilli of the bovine type and should therefore be made either from pasteurized milk and cream or from milk and cream obtained from cows which have been proved free from tuberculosis. This pasteurization of milk would also destroy dangerous germs of the colon and septicemia group;
- 3) that cottage and skim milk Neufchatel cheeses are much less frequently infected with the tubercle bacilli than cream cheese; but this should not be used as a reason for making them from raw milk.

500 - **The Digestibility and Utilization of Egg Proteins.** — BATEMAN W. G. (Sherrill Laboratory of Physiological Chemistry in Yale University, New Haven), in *The Journal of Biological Chemistry*, Vol. XXVI, No. 1, pp. 263-391, 8 Tables, Bibliography of publications. Baltimore, Md., August, 1916.

By means of experiments carried out on dogs, rats, rabbits and man the author arrived at the following conclusions:—

Raw egg-white is found to be a decidedly indigestible substance. It causes diarrhoea in dogs, rats, rabbits, and man when ingested in any large quantity. Its utilisation by the body is poor since it is used only to the extent of 50 to 70 per cent. Subjects can acquire a certain tolerance for the native protein after ingesting it for several days so that it no longer causes diarrhoea and is somewhat better utilized.

Raw egg-white can be made digestible through coagulation by heat by precipitation with alcohol, chloroform, or ether; by incubation with dilute acids or alkalis; by partial digestion by pepsin; by conversion into alkali-metaprotein.

The indigestibility of native egg-white probably lies either in its antitryptic content or in its chemical constitution. Its physical texture appears to play a minor part in its behaviour. Of the individual proteins constituting egg-white, the albumin fraction appears to be the indigestible component.

The whites of the hen's egg and duck's egg act alike in causing diarrhoea and in being poorly utilized.

Egg-yolk either raw or cooked is excellently utilized. It sometimes causes digestive disturbances in dogs, apparently because of its high fat content.

A review of the literature shows that dietitians have relied, in general, upon the early observations of BEAUMONT as support for the use of raw eggs. These observations were in the main exact; but, so far as the digestibility of raw egg-white is concerned, were misinterpreted. 1

rent dieto-therapy raw whole eggs, raw egg-white, and albumin-water extensively prescribed. There appears to be little in their conduct as to stuffs, however, to warrant such faith in their nutritive value or ease of assimilation.

12 - **The Vitamine Content of Brewers' Yeast.** — SEIDELL, ATHERTON (Hygienic Laboratory, United States Public Health Service, Washington, D. C.), in *The Journal of Biological Chemistry*, Vol. XXIX, No. 2, pp. 145-154, 4 Diagrams. Baltimore, March, 1917.

The author has studied the vitamine content of brewers' yeast as regards its efficacy for curing beriberi caused by a diet consisting exclusively of polished rice. His conclusions are given below.

In pigeons, the lack of vitamine in a diet consisting exclusively of polished rice can be exactly compensated for by daily doses of 0.5 to 1.0 cc. of the clear filtrate from autolysed brewers' yeast; doses of dried fresh-lysed yeast equivalent to about 1 cc. of autolysed yeast does not effectively replace the vitamine deficiency of a diet of polished rice.

Of 2 samples of dry yeast, one of which was autolysed before being fed and the other not, pigeons receiving the latter lost weight on a ration of polished rice much more rapidly than those receiving the former. The autolysis thus seems to have a favourable influence on the activity of the vitamine of brewers' yeast.

On the assumption that all the nitrogen contained in fullers' earth which has been shaken with autolysed yeast filtrate is derived from vitamine, the maximum quantity of the latter which can be present in the original yeast filtrate is 0.18 gm. per 100 cc.

The daily vitamine requirement of a grown pigeon is somewhat less than 1 mgm. A diet containing 0.0033 % of vitamine, given in quantities daily consumed by pigeons, will supply this requirement.

CROPS AND CULTIVATION

12 - **The Effects of Meteorological Factors on the Growth and Yield of Rice in the Vercelli District, Piedmont, Italy.** — MARCARELLI, B., in *Giornale di Riscultura*, Year VIII, No. 1, pp. 7-16. Vercelli, 1918.

AGRICULTURAL
METEOROLOGY

At the "R. Stazione sperimentale di Riscultura" of Vercelli, Prof. MARCARELLI has, for some years, carried out a series of agricultural meteorological studies by the modern scientific method of parallel observations. His object was the determination of the critical periods of rice in relation to the various meteorological phenomena and factors of the district.

The apparatus is in a cage specially placed at 3.94 ft. above the ground (average height of a fully grown rice plant); the air, water and soil temperatures are determined simultaneously by three Richard's recording thermometers, the bulbs of which are in the air, water, and soil (at a depth of 1 cm.), respectively.

The experiments on the *temperature of the irrigation water* are of great importance in the rice fields, because the possibility of cultivating rice in a

more or less unfavourable climate depends both on the initial heat of the water and the rise in its temperature as a result of its exposure to the sun in shallow sheets over large surfaces. It is, indeed, only the influence of the specific heat of the water which can reconcile to any extent the extreme of temperature in the atmospheric layer immediately in contact with the vegetation and prevent the great changes in temperature so harmful to rice. It is also under this influence that the heat of the submerged soil is modified during the day and remains higher, thus favouring a maximum development of the roots.

According to the author's previous experiments, the factors necessary for a good rice yield are : — a total of average daily temperatures amounting to 3 500 to 4 500°C. for the period from April to the end of September ; rainfall not exceeding 200-250 mm. ; a clear sky, expressed approximately by a total of fine and semi-cloudy days amounting to 140 to 170.

The *heat total* exceeds the other climatic factors in effect, but it must be regularly distributed without too frequent or excessive variations in the daily temperature. In Piedmont rice cultivation certainly does not suffer from the maximum temperature limit, for it is favoured by very hot seasons, but the minimum limit of resistance to low temperature is of great importance because of the phenomena connected with it during the various stages of the plant's development : — imperfect germination, yellowing of the young plants, limited stooling, non-setting, delayed ripening, etc.

The period in which rice is most sensitive to the air temperature coincides with the stooling stage. Although it is not exactly known if the marked need of the plant for heat at this period is due to the process of stooling itself or to the development of secondary rootlets, there is no doubt that the meteorological conditions are unfavourable at this stage the rootlets develop slowly and do not take a firm hold in the soil, so that the development of the plant is weak, causing it to succumb to the slightest disturbance, a lodge when ripe.

Temperature also has a marked influence on the flowering stage and the setting of the grain, which are more affected by the frequency and intensity of cold nights than by the normal average daily temperatures. Frequent low early morning temperatures during the last period of the development of rice are nearly always the cause of the failure suffered in the cultivation of late rice in the Vercelli district.

The *clearness of the sky* follows immediately on the "heat" factor the importance of its effects, especially on the quality of the product, and within certain limits, abundant light may compensate for slight deficiency in heat, as rice, by reason of its origin, demands sunny days.

Rain is harmful because it produces disturbances in the temperature round the rice field and decreases the clearness of the sky. Excessive moisture in September and October stimulates the development of the grain causing it to germinate in the drying sheds and sometimes even in the sheaves. This explains why the summer of 1917, whose severe and prolonged drought was detrimental to the production of all other cereals, was so extremely favourable to rice. The low temperatures, the negative

tion of which on the vegetative growth and maturation of the plant has already been mentioned, remained within the limits of 10 to 17°C. for the air, 18 to 21°C. for the water, and 18 to 25°C. for the soil, so that the most important biological phenomena of rice, such as stooling, flowering, setting grain, were in every case favoured by excellent temperature conditions, and gave most satisfactory results.

As a result of the great stability in the distribution of the climatic factors in 1917 for all varieties of cultivated rice (except "Bertone", subject "brusone" [scorching]), the critical phases of development, the period of which varied according to the earliness of the rice and the date of sowing, ways coincided with favourable meteorological conditions, which caused luxurious growth and a grain harvest as good as it was abundant.

- 13 - **Plants Resistant to Adverse Meteorological Conditions Obtained by Selection.**
— See No. 519 of this Review.

- 14 - **New Experiments in Dry Farming in Italy** — DE ANGELIS D'OSSAT, G., in *Le Stazioni sperimentali agrarie italiane*, Vol. II, Pt. 1-2, pp. 41-53 + 1 Diagram + 1 Fig. + 6 Tables. Modena, 1918. (Author's abstract, in Italian).

The author, professor at the "R. Istituto Superiore Agrario" at Perugia, carried out his previous field experiments on dry farming at the farm of his Institute (1). The characters of the soil were investigated by determining: — 1) its formation; 2) its lithological nature; 3) its mechanical constitution; 4) its chemical composition; 5) its physical behaviour.

The experiment field contained two adjacent plots; the soil of one was left hard, the surface of the other was frequently worked to a depth from $\frac{3}{4}$ to 1 inch. The soil samples for the various determinations were taken from a depth of 8 to 12 inches.

A table gives the data obtained from May 11 to August 3, 1917, for the height and volume of moisture in the unturned and turned soil and also atmospheric precipitation, daily moisture and air temperature.

The second part of the experiment (from June 27) gave positive results: — the average volume of the moisture in the turned soil was 13.095 %, it only 9.385 % in the unturned soil. The maximum, minimum and average differences were 7.45 %, 1.30 %, 3.71 % respectively.

From these results it may be concluded that:

1) In superficially turned soils (dry-farmed) the moisture content exceeds that of unturned soils.

2) to prevent damage by drought the soil should, therefore, be prepared in two ways: — a) during the rainy season it should be prepared as to allow the water to penetrate as much as possible; b) during drought evaporation should be prevented as much as possible by dry-farming.

By means of a special apparatus the author attempted to determine the relative capacity of clay and sand to raise underground water during surface evaporation. Although this experiment, made in the laboratory, is of no real practical value it has given interesting results. For a distance

SOIL PHYSICS.
CHEMISTRY
AND
MICROBIOLOGY

(1) See R. Feb., 1917, No. 119. (Ed.).

of 8 $\frac{1}{2}$ inches between the evaporating surface and the water table, the evaporated 265.7 cubic yards of water per acre monthly, and sand 234.6 cubic yards, or 31.1 cubic yards less.

505 - A Correlation Between Bacterial Activity and Lime Requirement of Soils. — Dean F. E. (Department of Agricultural Chemistry and Soils, Ohio State University), in *Soil Science*, Vol. IV, No. 6, pp. 433-462 + 3 Figs, Bibliography of 14 publications. Baltimore, December, 1937.

The fertility of limestone regions is well known. It is also known that soils lacking in carbonate of lime are made more productive by liming. Alfalfa, clover and maize are the plants which do best in lime soils. Many workers have, however, noted that certain plants flourish in non-calcareous soils, and are even injured by applications of lime. Strawberries, potatoes, rye, oats, millet, buckwheat, carrots, turnips, cowpeas, crimson clover, soy beans, serradella and lupins, are adapted to acid soils. These facts suggested to the author the possibility of a system of acid agriculture, i. e., in acid soils, in districts some distance from a lime supply. In the first place he studied the relation between the activities of soil bacteria and nitrogen accumulation and transformation, and the nitrogen requirement of certain soils containing from 0 to 2 300 parts of calcium carbonate per 1 million parts of soil. To various portions of this soil were added gradually from 0.01 to 2 % of calcium carbonate.

The results obtained from these experiments show that the various groups of soil organisms respond differently to applications of lime. Ammonification is fairly satisfactory in most soils, even without the addition of lime, but, as a rule, the addition of moderate amounts of lime increases the rate of ammonification, and small applications are relatively more efficacious than large ones.

On the other hand, the rate of nitrification is directly correlated with the amount of lime added; excessive applications are not injurious to the nitrifying bacteria, and soils with a high lime requirement show practically no nitrification until calcium carbonate has been mixed with them.

Nitrogen fixation by non-symbiotic soil organisms is also considerably increased by liming, but the addition of mono-calcium phosphate is necessary for maximum nitrogen fixation.

Pot experiments with soy beans showed that a lime requirement of 1 500 parts of lime per 1 million parts of soil was not sufficient to prevent good growth of soy beans in a soil well fertilized with acid phosphate or manure.

CONCLUSIONS. — 1) Plants which are able to utilise ammonia nitrogen do not suffer from nitrogen hunger when grown on soils having lime requirements not exceeding those studied in the investigations.

2) Plants which derive their nitrogen from nitrates may suffer from the lack of available nitrogen in soils having a high lime requirement unless this requirement has been at least partially satisfied.

3) The supply of nitrogen in acid soils may be maintained by growing acid-resistant legumes, of which the soy bean is one. There is no doubt that acid phosphate aids nitrogen fixation in acid soils.

4) As a rule, small applications of calcium carbonate are relatively more active than large applications for increasing bacterial activity in acid soils.

- **Drainage Ditching of Irrigated Lands in Colorado, U. S. A.** — *Engineering News Record*, Vol. CXXX, No. 6, p. 263, 2 Figs. New York, February 7, 1918.

The San Luis valley, Colorado, is level and without rivers or ravines to afford natural drainage for the water coming from higher levels. Beneath the gravelly subsoil there is water under pressure, and nearly every ranch is a flowing well, many of which run continuously, causing an additional amount of surface water. Under these conditions the land in the valley becomes waterlogged and therefore requires drainage.

The drainage work is being done by the CHARLES & GIBSON Co. of Armosa, Colorado, which owns large tracts of the land and develops them for settlement.

The drainage ditches, of which over 100 miles have already been excavated, are made by 3 AUSTIN excavators. The ditches are 8 ft. wide on the bottom, with slopes of 1 on 1 $\frac{1}{2}$. They are mainly 6 to 8 ft. deep; but the machines can cut to a depth of 11 ft.

The excavated material is deposited on both sides of the cut, leaving the banks, so that in the future a machine can be run over the ditch for the purpose of cleaning and reshaping it. The machine works night and day (except Sundays), being equipped with an electric plant for lighting. The day shift consists of 5 and the night shift of 4 men. The machine can excavate 800 to 1000 cu. yd. per 10-hour shift.

- **Irrigation of Alfalfa in the United States.** — I. BECKEY, S. H. and ROBERTSON, R. D., in the *College of Agriculture, Agricultural Experiment Station, Bulletin No. 260*, pp. 273-294 + 2 Figs. + 4 Tables. Berkeley, California, May, 1917. — II. FORTIER, SAMUEL, in the *U. S. Department of Agriculture, Farmers' Bulletin No. 865*, pp. 40 + 50 Figs. + Tables. Washington, December, 1917.

I. — Experiments carried out during six years at the Farm of the University of California at Davis, and observations made during one or two years at 51 alfalfa-growing farms in the Sacramento Valley, California, yielded the following data with respect to the irrigation of alfalfa in this district: —

Soil	Depth of water required to produce good alfalfa, inches	Depth of water required per acre, depending on depth of soil, inches	Number of irrigations per season	Size of border strip checks		Suitable grade, inches per 100 feet	Size of irrigating head per second, per check, cu. ft.
				width	length		
				feet	feet		
Hum loam,	30-36	6-9	3-5	30-50	300-600	3-6	2-10
7 gravelly or sandy	48-60	3-4	2-3 per cutting	100	100	-	5-6
dry	30-36	2-4	2-3 per cutting	30-50	300-600	1-3	1-4

The experiments, the results of which are given in the above table aimed at determining:— 1) the amount of water necessary to produce good yields of alfalfa in the light and heavy soils of the Sacramento Valley; 2) the amount of water required for irrigation; 3) the most suitable heads; 4) the soil moisture required to prevent wilting; 5) the amount of water necessary to assure the best growth of alfalfa. These experiments are described in the bulletin under review which itself is but a summary of more complete description of the investigations.

II. — The *Farmers' Bulletin No. 865* on the irrigation of alfalfa in the United States is a revised edition of *Bulletin No. 373*, published in 1909. The various methods of irrigating lucerne are described, together with the methods of preparing the soil. A description is given of the different types of levellers and other apparatus for constructing the dikes, as well as the information necessary for constructing the canals, ditches, gates, and outlet valves. In the United States 95 % of the alfalfa fields are subjected to surface irrigation, the other 5 % to sub-irrigation. Near the towns of Anthony and Sugar City, Idaho, where the soil is composed of sand and gravel, 60 000 acres are irrigated from below.

The amount of water to be applied to alfalfa in the various districts of the United States is set out in tables. On account of the rapidity of its growth and the number of cuttings during a season, alfalfa requires more water than other crops. This sometimes leads to the use of too much water, which should be avoided. No fixed dates for irrigating alfalfa can be given; the appearance, and, more especially the colour of the plant, are the best indications of its need of water.

508 -- **The Progress of the Nitrogen Industry.**— BERTRAND, A., in *Anexo al Boletín Mayo de la Asociación Salitrera de Propaganda*, pp. XXXVIII + 363. Valparaíso, 1917.

Review of publications relating to the nitrogen industry in the nitrate-producing countries, especially during the war. There are 5 parts, dealing with Germany, Chile, United States, France, Great Britain. In 11 appendices are given:— a paper by the Badische Anilin- und Sodafabrik on the monopoly of nitrogen in Germany; a study by P. EHRENBERG, professor of Agricultural Chemistry at the University of Göttingen, on the organization of this monopoly; the nitrogen question at the United States Congress; a list of publications on the net cost of nitrate of soda; a list of members of the Nitrate of Soda Council since its foundation; a list of information regarding propaganda for nitrate of soda in various countries; a list of articles published in Chilean periodicals from 1907-1914 on the efficaciousness of the propaganda for nitrate of soda; a list of articles published in the above-mentioned periodicals on synthetic nitrogen products; a bibliography of the Chilean press relating to the organisation of the nitrate industry; a list of studies, projects and inventions relating to that industry; a general bibliography of the names of authors arranged in alphabetical order.

It constitutes a very full compilation of information relating to the production of nitrogenous fertilisers and their application.

The author shows that in Chili there is a lack of a publication giving trade of soda statistics in full and giving information as regards the production, consumption, price, etc., of other nitrogenous products. He finds at that want has been provided for:—

1) by the monograph on the "Production and Consumption of Chemical Manures in the World", published by the International Institute of Agriculture in 1914, followed by a second edition in the same year;

2) by the half-yearly publications on the "International Trade in Fertilisers and Chemical Products useful to Agriculture", commenced in September 1914, and based on the above monograph, by the Bureau Agricultural Intelligence of the above-mentioned Institute;

3) by Part IX of the Yearbook of Agricultural Statistics, also published by the International Institute of Agriculture, which gives data regarding the production, trade and prices of chemical fertilisers for the preceding 10 years.

The author hopes that these publications will be distributed as widely as possible in Chili, and that they will lead to treating nitrate of soda statistics in the same way as others, especially if the review of "International Trade in Chemical Fertilisers" is published quarterly and then, as soon as possible, monthly.

The author considers that the war has shown that combined nitrogen is the elementary chemical basis of explosives as well as feeding and textile stuffs, so that the importance of a country can very well be measured, whether in peace or in war, by considering its capacity for producing combined nitrogen.

99—**Spanish Mineral Products Employed in Agriculture.**—**NAVARRO, B.** in *Iberica*, Year V, No. 216, pp. 121-124. Tortosa, February 23, 1918.

Of the various mineral products of Spain the following are of value in agriculture, either for their use in the manufacture of fertilisers, or in the control of insects and disease:—

PHOSPHORITES.—These are obtained in the province of Cáceres, where there are four mines the total yield of which in 1916 amounted to 14 200 metric tons, giving an average of 50 % phosphoric acid, valued at about £10 000.

There are 14 superphosphate factories:—3 at Barcelona, 1 at Cáceres, 1 at Huelva, 1 at Seville, 1 at Córdoba, 2 at Málaga, 1 at Murcia, 1 at Navarre, 1 in the Asturias, at 2 at Valencia. The total production of superphosphates rose, in 1916, to 315 180 metric tons, valued at £1 389 000 (1).

AMMONIUM SULPHATE.—There are 17 factories at Barcelona and others at Oviedo, which, by distilling coal, produce 2 720 metric tons of ammonium sulphate. The figures quoted are for 1916; those for 1917 are believed to be much higher.

(1) The superphosphates are chiefly produced from imported phosphates. Cf. *Intern. Inst. of Agriculture, The International Trade in Fertilisers and Chemical Products Employed in Agriculture* (Half-yearly review). (Ed.)

SULPHUR. — Sulphur-containing material ("tierras azufrosas") is obtained from a number of deposits: — 1 at Alicante, 2 at Almería, 5 at Murcia and 2 at Teruel. The total yield in 1916 amounted to 47 000 tons, with an average sulphur content varying from 12 to 25 % (Almería). The amount of sulphur obtained from raw material was 11 000 tons, worth about £ 109 000. This production is believed to have made Spain independent of imports.

COPPER SULPHATE. — Until recently this was not produced in Spain in spite of the many deposits of copper-containing minerals. In 1916 two factories at Barcelona and one at Córdoba produced a total of 7 600 tons, valued at £ 400 400.

510 — **Fertilizers in Australia.** — in *Commonwealth of Australia, Advisory Council of Science and Industry, Report of Executive Committee for the Year 1916-17*, pp. 32-31 Melbourne, 1917 (1).

Australia is largely dependent on outside sources for the raw material of artificial fertilizers and the Executive Committee of the Advisory Council of Science and Industry appointed in 1916 by the Governor-General has devoted much attention to the consideration of possible local sources of phosphates, potash, and nitrogenous fertilizers with a view to reduce this dependence of Australian agriculture on foreign countries.

Potash. — Of most pressing importance is the need for developing local sources of potash, since Australia, in common with the rest of the world was before the war dependent on the potash deposits of Stassfurt, Germany, for her supply of this chemical. Besides the use of potash for fertilizers, it is required in various secondary industries, such as the manufacture of soap, cyanides, explosives, and fireworks. The problem is not peculiar to Australia, and the Committee have obtained reports and other information as to the inquiries into new sources of potash which have been conducted in the United Kingdom and the United States of America. The sources of potash which have been suggested are *a)* alunite; *b)* kelp; *c)* suint; *d)* molasses; *e)* wood-ashes; *f)* ground igneous rocks; *g)* saline deposits.

a) Alunite is a mineral consisting of the sulphates of potassium and aluminium, of which there is a very large deposit at Bullahdelah, in New South Wales, and smaller though pure deposits in South Australia. The Bullahdelah deposit was formerly mined and shipped to England for the manufacture of alum, but this industry is now at a standstill. A special Committee was appointed to consider the best means for utilizing alunite, for which the Australian deposits are the most extensive in the world, specially with a view to ascertaining the best treatment for the extraction of the potash. This Committee has almost reached a stage when it can definitely state that no serious technical difficulties stand in the way of any one desiring of producing sulphate of potash and alumina from Australian alunite, but having regard to the nature of the operations involved the manufacture of sulphate of potash could be carried on with profit if done on sufficiently large scale by means of modern appliances, always provided that a local market for the output of the plant could be obtained; in other words the difficulties if any, in the way of developing the alunite industry are economic rather than technical.

(1) See INT. INST. OF AGR., *Production et consommation des engrais chimiques dans le monde* II ed., 1914, and the half-yearly reviews *The International Movement of Fertilizers and Chemical Products Useful to Agriculture*, (Ed.)

b) The large brown seaweeds known as kelp contain a considerable quantity of potash, but species from different localities vary considerably in their content, and few investigations appear to have been made as to the composition of Australian seaweeds.

From press reports it appears that a small plant for treating kelp has been established in Tasmania, and is producing potassium chloride. The Committee are making further inquiries on this subject.

c) Suint, or wool-grease, contains a certain amount of potash, and if the whole Australian clip were scoured in Australia and the potash extracted, this would probably suffice for all needs. The recovery of potash in wool-scouring must be considered in connexion with the production of lanoline.

d) The recovery of potash from molasses has been considered by a sub-committee of the Queensland State Committee appointed to review the possible means of utilizing molasses. They did before them details of a proposed method, which had been brought before the Executive Committee, for absorbing the molasses with megass, producing charcoal and gas therefrom, and then burning the charcoal to an ash from which the potash could be recovered. They reported that all methods hitherto tried for recovery of potash from molasses have led to only small proportions being finally recovered, and that the prospect of burning to ash with megass did not appear at all promising, even in war-time.

e) The extraction of potash from the wood ashes of saw-mills and of eucalyptus distillation plants has been suggested, and the Executive Committee has collected evidence on the subject which points to the conclusion that the amount of potash is too small to render this a commercially profitable source. It is understood that experiments are being conducted as to the feasibility of extracting the potash from the ash left when prickly pear is burnt.

f) The utilisation of ground igneous rocks as potash fertilizers has often been discussed, particularly in the United States. These discussions have related chiefly to orthoclase felspars or orthoclase-bearing rocks, but it was suggested to the Committee that leucite-bearing rocks might be more suitable from this point of view. The subject was referred to the Chemical Committee, which came to the conclusion that these rocks were unlikely to be able to compete with alunite as a source of potash.

g) The most satisfactory solution of the potash difficulty would be the discovery of a saline deposit in Australia rich in potash salts. It seems not improbable that such a deposit might exist in some of the lake basins of Central Australia, and it is worth consideration whether an investigation of the deposits in the beds of the salt-lakes of the Commonwealth should be undertaken.

Phosphates.—The possibility of increasing the local supply of phosphatic fertilizers depends on either a) the discovery locally of rock phosphates suitable for the manufacture of superphosphates, or b) the discovery of means whereby the phosphates of iron and aluminium, of which there are considerable deposits in Australia, can be made available as sources of phosphorus to crops.

The Executive Committee has made inquiries in all the States as to the likelihood of discoveries of rock phosphates, but the replies received are not very encouraging. Islands off the coast of North-western Australia and Queensland are regarded as the most probable localities to search, and prospecting in these localities should be encouraged. The known deposits of calcium phosphate on the mainland are small. Experiments as to the fertilizer value of iron and aluminium phosphates under different conditions are in progress in Victoria and Western Australia, and the Committee is considering the appointment of a Special Committee to co-ordinate these researches.

Nitrates. — The question of the production of nitrates from atmospheric nitrogen has also been considered. The utilization of atmospheric nitrogen, to be commercially successful, depends on the presence of a cheap source of power, and it seems possible that ultimately the Tasmanian hydro-electric scheme may be utilized for this purpose. Three different processes are at present in operation in other countries, but under present conditions it is impossible to obtain evidence as to which of these should be established in Australia, and it is certain that an expert familiar with them would need to be employed in the establishment of plant for the purpose in Australia. The Committee have come to the conclusion that, as there is no immediate prospect of Australia being cut off from the supply of Chili saltpetre, the matter should be left until the conclusion of the war.

511 — **Manganese Sulphate as a Catalytic Fertiliser for Sugar Beets.** — See No. 52, 4 this *Review*.

512 — **Cyanogenesis in Plants, Studies on *Tridens flavus* (Tall Red Top).** — VIEHOLTER A., JOHNS, CARL O. and ALSBERG, CARL L. (Bureau of Chemistry, United States Department of Agriculture, Washington), in *The Journal of Biological Chemistry*, Vol. XXV No. 1, pp. 141-149. Bibliography of 7 publications. Baltimore, Md. May, 1916.

The authors confirm the presence of notable quantities of hydrocyanic acid in *Tridens flavus*, a common grass widely distributed in the United States, occurring from Massachusetts to Kansas and south to Texas. The whole plant, including the roots, collected in August and examined without drying yielded 0.0075 per cent. of hydrocyanic acid. These plants after drying in desiccated air at 50°C. retained 0.0066 per cent. of hydrocyanic acid, and this quantity still remained after the dried plant had been ground and left exposed to the laboratory atmosphere for 3 months. The August plants dried for more than a month at 60°C. gave the following distribution of the hydrocyanic acid:—inflorescence tops stripped of flowers, 0.0037 %; stems, 0.0030 %; green leaves, 0.0017 %; dead yellow leaves, 0.0000; root, trace. Thus the maximum quantity of hydrocyanic acid was found in the inflorescence tops. The ripe seed did not contain hydrocyanic acid. Only a trace of hydrocyanic acid was found in plants collected in September, and none in October plants.

No free hydrocyanic acid was obtained by direct distillation with steam; by maceration with water, and subsequent distillation with acid, less hydrocyanic acid was obtained than by direct distillation with acid. Distillation of the macerated or unmacerated plant without the addition of acid resulted in a partial or complete loss of the available hydrocyanic acid.

The quantity of hydrocyanic acid obtained from *Tridens flavus* was not increased by macerating with emulsin.

When the plant was macerated in water containing a known weight of potassium cyanide, considerable loss of potassium cyanide resulted. If tartaric acid was present during the maceration of the plant with potassium cyanide, all the latter could be recovered; when sodium hydroxide was

present the loss of potassium cyanide was complete. The loss of cyanide during maceration is probably due to a chemical reaction.

Tridens flavus contains an enzyme which hydrolyses amygdalin.

513 - **Researches on Carotin and Its Possible Toxicity.** -- See No. 542 of this Review.

514 - **The Origin of the Resins in the Pine.** -- DURÉNOY, J., in the *Revue générale des Sciences*, Year XXIX, No. 1, p. 3. Par's, January 15, 1918.

The origin of resins in plants may be explained either histologically or cytologically, according to whether they are the transformation products of the cell membranes or of the cell contents or reserves (leucites).

Lignified membranes may become resinous; in such a case they give the reactions for pectic membranes; they can fix metallic bases and are stained orange with safranin (which stains lignin cherry-red).

In the bacterial tumours of *Pinus maritimus* the contents of the tumour become resinous.

In the needles of *Pinus maritimus* attacked by rust (*Peridermium*) the resin proceeds directly from the secretion or transformation of the chloroplasts. In unfixed sections stained directly by Soudan III in glycerine, the resinous globules can be seen forming and growing in contact with the chlorophyll grains; several globules may unite into one while the various chloroplasts that took part in their formation remain in the periphery of the globules.

In a healthy needle, the oleo-resinous globules are also less abundant in the chlorophyll-free perisperm than in the green parenchyma.

The secretion of resin is thus a very complex phenomenon, and the process of formation varies greatly according to the case under consideration; but it is never formed by the secreting canals, which are probably only collecting organs.

515 - **The Effect of One Growing Plant on Another.** -- RUSSELL, F. J., in *The Gardener's Chronicle*, Vol. LXIII, No. 1621, pp. 23-24. London, Jan. 19, 1918.

From time immemorial gardeners have been convinced that certain plants injure others, and, in many cases, it is firmly believed that the harmful effect remains in the soil for months, if not for years. This has led to the opinion that certain plants excrete something from their roots which is poisonous to other plants of the same kind, though not necessarily so to those of a different kind. For a long time the plant was considered as completely analogous to the animal, and, thus, the scientist agreed with the practical man in admitting the existence of a poisonous excretion in plants. Of recent years, however, much doubt has been thrown on the idea of a poisonous excretion, and serious obstacles have been shown to hinder its acceptance. In a good grass field, for example, the plants are as crowded as they can be, yet they show no signs of "sickness" or poisoning. If the soil be poor the plants may go hungry, but this may be remedied by applying suitable fertilisers; there is nothing in the appearance of the plants to suggest that any other factor is concerned.

On the other hand, some years ago Dr. WHITNEY, chief of the Bureau of Soils of the U. S. Department of Agriculture, expressed the opinion that

plants do excrete a toxic substance which may, however, be precipitated or rendered inactive by fertilisers. Therefore the improvement of plants by fertilisers is due, not only to the food they supply, but also to the above-mentioned action, and perhaps to others as well. WHITNEY'S hypothesis gave rise to much discussion, which led to a great deal of progress being made on the subject.

British investigators have usually taken the view that there is no evidence of a persistent toxic excretion. The experiments at Rothamsted seem to bear this out. At the present time the famous Broadbalk field is carrying its 75th. successive crop of wheat, and the plants look as well as any on the farm, and better than a good deal of the wheat in the district. The last crop of mangolds was the 42nd.; it was well above the average and has rarely been exceeded during the whole period. Similarly, barley has been grown for 57 years in succession without showing any signs of suffering. Leguminous crops, however, cannot be grown in this way, and after a short period, fail; they are the only crops which experimental evidence has shown cannot be grown year after year on the same land. Observations show, nevertheless, that other plants also fail in the same way; the foxglove grows splendidly in the soil of a freshly cleared wood (provided the soil is suitable, e. g., the clay patches on the Downs) but for one year only not longer. It is also said that flax and onions may fail if grown too often in the same soil. These, however, are all simply observations which, even if exact, may have some other explanation.

The idea that plants excrete poisonous substances has been investigated by Mr. SPENCER PICKERING. The growth of plants was found to be considerably decreased if they received water which had washed part of the roots of another growing plant. This effect seems to be general; the washings from the roots of mustard check the growth of mustard; those from grass check the growth of fruit trees, and so on. It was possible to establish the important point that these washings lose their poisonous quality very rapidly, so that they do not necessarily affect the soil after plant growth has ceased. These experiments are, therefore, perfectly consistent with those of Rothamsted described above.

Another set of Rothamsted experiments is, however, more difficult to reconcile with Mr. PICKERING'S results. Dr. WINIFRED BREXCHLEY grew wheat alone, weeds alone, and wheat mixed with weeds. She observed that when poppy (*Papaver Rhoeas*), black bent (*Alopecurus agrostis*), and spurry (*Spergula arvensis*) were grown with wheat they made less growth than when grown alone; on the other hand, wheat made more growth per individual plant (1). This, of course, does not mean that wheat should always be grown with weeds; the plants would have done better had no weeds been present, but they suffered less from the presence of the weeds than they would have done from an equal number of wheat plants. In these experiments spurry proved more harmful than the other weeds because, by its straggling habit it badly checked the young wheat

(1) This work is summarised in *R.* July, 1917, No. 625. (Ed.)

which never recovered properly. Charlock and wheat settle down to some sort of equilibrium as neither masters the other.

So far as could be seen, the effect was solely one of competition for food, and it made no difference to the individual wheat whether it competed with another wheat plant or a plant of a completely different order. The whole phenomenon could be explained by the supposition that the number of plants the soil can carry depends on the amount of plant food present in the soil and the amount of space available for growth; if the food and space are to be divided, each individual will get a smaller share and will, consequently, make less growth than if there were fewer plants present. At first sight these results seem difficult to reconcile with those of PICKERING's experiments, which seem to prove that a large number of plants suffer not only from starvation, but also from mutual poisoning, so that growth would be less both individually and collectively than when a smaller number is grown. The apparent disagreement may, however, be explained. In another of Mr. PICKERING's experiments plants grown in plots divided into compartments so that each individual root was kept separate from its neighbour made no better growth than did plants in undivided pots where the roots of the different plants mixed freely. Thus, the toxin produced by one individual plant does it as much harm as that produced by its neighbour. Further Mr. PICKERING found, in open soil, that the total growth was the same whatever the number of plants (within certain limits of distance apart) or, in other words, that the weights of the plants were inversely proportioned to the bulk of soil available. This is in full agreement with Dr. BRECHLEY's results and may be explained perfectly well, without assuming the existence of a toxin, simply by the fact that the full crop-bearing capacity of the soil has been reached. If, with Mr. PICKERING, a toxin is assumed to be present, it must be supposed to be at least as harmful to the plant itself as to any other. This assumption involves possibilities which new experiments should investigate.

316 - **Action of Magnesium Salts on Wheat.** — VOELCKER, J. A. (The Woburn Experimental Station of the Royal Agricultural Society of England, Pot-Culture Experiments, 1916), in *The Journal of the Royal Agricultural Society of England*, Vol. LXXVII, p. 260-262. London, 1916 (published in 1917).

In continuation of the experiments on the action of magnesia the author considered it desirable to study the action of magnesium compounds other than the oxide and carbonate. To this end he used the chloride and the sulphate (in the anhydrous state) in quantities equal to 0.10, 0.15, 0.20 and 0.40 % of the soil. The soil used contained 0.30 % of lime and 0.22 % of magnesia, giving, with the addition of the magnesia salts, a ratio of 1 : 0.88. The experiments were made with pot-cultures of spring wheat; growth was observed and the harvest analysed. The results obtained, as well as those from previous experiments (1), led to the following conclusions: —

(1) See B. 1915, No. 900. (Ed.)

1) The action of magnesium compounds on wheat varies very greatly according to whether they are present as the oxide, carbonate, chloride, or sulphate.

2) The chloride may be used beneficially up to quantities of 0.10 % of the soil (1 ton per acre); in larger quantities it injures or totally destroys the crop.

3) Magnesium sulphate may be used safely and advantageously in quantities up to 0.40 % of the soil (say 5 tons per acre).

4) Increased nitrogen content, such as obtained in cereals by the use of magnesium oxide, is not produced by magnesium sulphate.

517 - **Action of Sodium Compounds on Wheat.** — VOELCKER, J. A. (The Woburn Experiment Station of the Royal Agricultural Society of England, Pot-Culture Experiment 1916), in *The Journal of the Royal Agricultural Society of England*, Vol. LXXVII, pp. 262-264, London, 1916 (published in 1917).

In correlation with his work on magnesium (1) and by the same method, the author carried out experiments with pot-cultures of wheat using anhydrous sodium hydrate, carbonate, chloride and sulphate in quantities of 0.01, 0.03, 0.10, 0.15 and 0.20 % of the soil for the two first compounds and 0.10, 0.15 and 0.20 % for the last two. The hydrate was applied in solution, the other compounds in the solid state.

CONCLUSIONS. — 1) The different sodium compounds have very different effects both on the germination and the growth of the wheat.

2) The hydrate and carbonate at first retard germination, but eventually have a beneficial effect even when applied in amounts equal to 0.20 % of the soil, or 2 $\frac{1}{4}$ tons per acre. Besides an increase in grain there is also an increase in nitrogen content.

3) Sodium chloride has a beneficial effect if not used in quantities exceeding 0.10 %, i. e., 1 ton per acre, but is harmful to germination and production when used in larger quantities, and, if applied in amounts of 0.20 %, corresponding to 2 $\frac{1}{4}$ tons per acre, may destroy the plant entirely.

4) Sodium sulphate affects neither germination nor production and may be used without detriment in quantities up to 0.20 %, or 2 $\frac{1}{4}$ tons per acre.

5) Both sodium hydrate and carbonate cause "caking" of the soil; this was noticed neither with the chloride nor the sulphate. The first two compounds also darken the soil. In practical agriculture caking would doubtless prevent proper aeration of the soil and free growth of the plants.

518 - **The Toxic Action of Soluble Aluminium Salts upon the Growth of the Rice Plant.** — MIYAKE, K. (Rudolph Spreckels Physiological Laboratory of the University of California, Berkeley), in *The Journal of Biological Chemistry*, Vol. XXV, No. 1, pp. 23-28, Baltimore, Md., May, 1916.

The matter of soil acidity is one of the chief topics of the day among soil investigators. There has been a vast amount of investigation on the subject and it has come to be quite generally recognized in recent years that

(1) See No. 516 of this Review. (Ed.)

the addition of various kinds of salt solutions to soils, soluble acids or acid-acting salts are set free: that is, cultivated soils tend to become acid year by year as a consequence of the application of manures and fertilizers containing soluble salts, because when nitrates, chlorides, and sulphates are added to soils, the tendency is for the base to combine with the organic matter and the silicates in the soil, and for the acid radicle to combine with aluminium and to a less extent with iron. The soluble aluminium and iron salts which are formed are more or less hydrolyzed in solution, with consequent setting free of soluble acid; that is, the presence of excess acid in the soil. Of course the acid radicles combine with the stronger bases, such as calcium and magnesium, but the acid condition of any soil is due to the fact that it does not have a sufficient supply of the strong bases; hence in many soils aluminium and iron necessarily supply the basic radicle. Thus happens that in many cases the apparent acidity of the extract from a soil as determined by titration with standard alkali in the presence of phenolphthalein, is found to be proportional to the amount of aluminium salts present in the solution, and evidently represents the amount of alkali required to precipitate the aluminium rather than actual free acidity. Accordingly, the addition of strong bases as calcium to the soil or treatment such as ignition which makes soil constituents less reactive, will stop or decrease the production of acid by the application of soluble salts to the soils.

From the view of soil acidity above stated, it appeared to be of interest to investigate the toxicity of soluble aluminium and iron salts and its relation to their acidity. As the soluble iron salts are generally present in negligible traces in the soil solution the author has confined his investigation to aluminium salts.

A review of the available literature shows that, although there is evidence that aluminium salts are toxic, there has been no research work done on the question of the relationship of the toxicity of aluminium salts to their acidity except one article by ABBOTT, J. B., CONNER, S. D. and KALLEY, H. R. (*Indiana Experiment Station Bulletin* 170, p. 329, 1913) which touches on this matter.

The author employed cultures of young rice seedlings 10 mm. high in solutions of aluminium chloride in concentrations of $\frac{N}{1000}$ to $\frac{N}{20000}$ and hydrochloric acid of the same concentrations for comparison, while cultures in distilled water served as a control. After 13 days the plants were assayed; their difference in development was striking. The concentration of hydrogen ions in some of the solutions of aluminium chloride was assayed by the method of the gas chain. From the results the following conclusions are drawn:—

Aluminium chloride is toxic to the growth of rice seedlings even in dilute solution. This toxic effect appears in concentrations greater than $\frac{N}{2000}$; it seems to be approximately equal to that of hydrochloric acid of the same normality; it is not due to the hydrogen ion formed by hydrolysis of the salt in solution.

The concentration of hydrogen ions formed by the hydrolysis of aluminium chloride is less than that formed by dissociation of hydrochloric acid of the same normality. Since the chlorine ion is not toxic to the growth of rice seedlings in such dilute solution, colloidal aluminium hydroxide or unhydrolysed aluminium chloride molecules or aluminium ions may be the toxic factors.

The toxicity of soluble aluminium salts is dependent upon the amount of aluminium itself. The determination of soil acidity by titration in which the soil extract is titrated with standard alkali is a logical method of determining the amount of bases which should be added to the soil for the improvement of its infertility; because, although the titration does not indicate the true acidity of the soil, yet it does afford a measure of the bases which must be added to neutralize the free acid and decompose the aluminium salts, either or both of which may be responsible for the infertility.

519 — **The Selection of Plants Resistant to Diseases, Animal Pests and Adverse Meteorological Conditions.** — MOLZ, E., in the *Zeitschrift für Pflanzenzüchtung*, Vol. V, Pt. 1, pp. 121-241. Berlin, 1917.

Amongst the individual specimens of some variety of plant liable to attack by diseases and pests, it is not uncommon to find some whose resistance surpasses not only the average resistance of the variety under consideration, but even surpasses the average resistance of varieties considered as resistant. In addition, the cross between two susceptible individuals sometimes gives progeny notable for a high resistance. This leads up to the problem of the creation of resistant types by means of individual selection and suitable crossings, and it suffices to consider the enormous expense due to the application of fungicides and insecticides to obtain an idea of the economic importance of varieties which, without any treatment, can remain free from pathogenic agents, or which, if they are attacked, do not suffer.

There are 2 forms of immunity:—

1) *Mechanical immunity*, due to the formation of differentiated cell layers around the infected part so as to isolate it completely and prevent pathogenic agents from penetrating into the body of the plant.

2) *Chemical immunity*, due to the presence of substances which repel or poison the pathogenic agent; for instance, the resistance of the African cacao tree to the attacks of the larvae of *Ephestia clutella* is due to the richness of the bark in tannic matter, which is, on the contrary, present in a small amount in the fruit of the Guatemalan and Venezuelan varieties which are more liable to be attacked by these larvae.

In the apple the tannin is replaced by a phenol which, under the action of an oxydase, may change into a tannoid substance, and this change takes place just at the time when, owing to a wound or other cause, the fruit is particularly exposed to infection.

In the vine, varieties resistant to mildew and oidium, like Rupprecht-Berlandieri, Riparia and their various hybrids, have leaves with sap 4.3 to 10.3 % acidity (expressed as tartaric acid and calculated on the dry matter), whilst hybrids very sensitive to these fungi, like *Vitis pinifolia* Gutedel × Berlandieri, Cabernet × Berlandieri, Aramon × Rupprechtieri, have

ries with an acid content of not more than 0.5 to 2.6 %. Similarly, resistant varieties give a more acid must than susceptible ones.

The defensive action of citric acid is very feeble. In the apple, malic acid is no protection whatever against *Botrytis cinerea*, which even develops more vigorously in presence of that acid.

Generally speaking, substances which favour the development of mycelium are called "chemotaxic", such as the sugars, for example. But on the other hand they increase the plant's resistance to low temperatures.

As regards the plant's resistance to diseases and pests, chemical immunity is of the greatest importance, so much so that the plant breeder has to take into consideration the results of analyses and to know intimately the chemistry of the plant cell.

INDIVIDUAL SELECTION — may be carried out in two ways:

- 1) by isolating those individuals that are not attacked;
- 2) by isolating those plants which, although attacked by the pathogenic agent, are not severely damaged.

In any case the first selection should be made from as large a number of individuals as possible, since the special resistance of a number of them is not intrinsic and hereditary, but depends on special environmental conditions, such as more suitable soil, the exposure to light, good manuring, etc.

In order to produce varieties of vine resistant to phylloxera, cuttings of plants having shown special resistance are planted in separate groups (pure lines); after 4 years, from each are taken 3 groups of cuttings which are to be planted in 3 localities having very different topographical, agrological and cultural conditions; those lines that give positive results in the tests will afterwards provide the material for forming a plantation of resistant varieties.

The presence of correlations between the character "resistance to a ven disease" and certain other characters will be of very great help to the plant breeder. Some examples of this are given below.

1) The spelt (*Triticum Spelta*) varieties from Turkestan and Samara, which are very resistant to brown rust (*Puccinia triticea*), can be distinguished from the resistant west European types by the shape of the glume, which is not obtuse, but has a mucronate point bent inwards to form a hook.

2) According to Swedish observers, there is a positive correlation between the characters "resistance to cold" and "resistance to disease". This is specially the case with *Urtica pratensis*, *Poa serotina* and *Festuca pratensis*, as far as regards resistance to *Sclerotinia blight*.

3) According to BABO and MACH, plants of *Vitis Berlandieri*, which had done well on the chalky soils of the Charente district, without showing signs of chlorosis, can be distinguished by golden-yellow, velvety leaves.

4) The hybrids *Berlandieri* × *Riparia Teleki*, whose shoots have a red, smooth and shiny epidermis, while the tip is bronzed (not red), are the most resistant to chlorosis.

5) The colour of seeds shows correlations which are easily noted and which may be of practical use. Thus, the more the spermoderm of the seed of *Trifolium pratense* and *Lupinus pratensis* is dark-coloured (reddish-yellow to deep red), the more the plants obtained from such seeds will be resistant to mildew.

HYBRIDISATION. — The resistance of a hybrid may surpass that of its parents. For example, the two wheats "Bore" and "Line 0728"

are affected by rust to different degrees, corresponding respectively to the figures 4 and 2. In their F_2 cross, numerous forms were obtained, some of which were more resistant to rust than the more resistant parent, as is shown by the following figures:—

6 forms having a degree of resistance equal to 0									
6	1	1	2	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1

In cases like this, the degree of resistance of the hybrid evidently corresponds to the sum of the factors present in each of the parents ($A, B, C, D, E, F = ABCDEF$). In a similar way the possibility can be shown of obtaining resistant types by crossing susceptible ones, when, in order to determine the "resistance", both groups of factors must be present simultaneously. Thus in crossing "Up to Date" and "Yellow Norwegian" potatoes, both susceptible, NILSSON obtained in the F_2 , 20% of individuals having a high degree of resistance to *Phytophthora infestans*.

But as, on the other hand, it is impossible to find out what are these determining factors and what is their number, at least one parent in each crossing should have a high degree of resistance.

Excellent material for hybridisation is to be found in wild varieties or in native varieties cultivated since time immemorial in some given locality and completely acclimatised. In time, by natural selection the weak or susceptible forms will have disappeared, leaving the progeny of the more resistant parents. In 1840 a terrible invasion of *Phytophthora infestans* destroyed the potato crop over a great part of Europe; the few surviving plants became the parents of new varieties possessing a great resistance to this disease.

By crossing wild varieties of fruit trees with cultivated forms, HANSEN has obtained, in the United States, types of fruit trees showing great resistance to cold.

In this and similar cases, it is most important to use abundant material, for, in the great mass of possible combinations (given the large number of determinants), only a small number of individuals will present the desired characteristics, so that, if the observations are limited to a small progeny it may easily happen that the desired type will not be found.

By means of selection and hybridisation followed by selection, types may be created that are specially resistant to diseases, pests and adverse weather conditions, as is shown by the results already obtained in many countries:

1) GERMANY. — Since 1896, BEHRENS has obtained, by suitable crosses, a type of tobacco resistant to *Bacillus maculicola* Delacr., just as STRUB was able, by selection, to increase the resistance of his spring wheat "Schlanstedter" to the attack of *Ustilago triticea*. On the other hand ARNIAN has obtained potato varieties resistant to *Phytophthora*, and VOLOCHOV has isolated from the "Wohlmann" variety of potato, some type resistant to leaf-curl caused by *Fusarium* spp.

WANNER and RASMUSSEN are trying to obtain varieties of vine resistant to phylloxera, and H. C. MÜLLER and the author started a series of trials in 1912 in order to obtain a type of sugar-beet resistant to *Grodera Schachtii* A. S.

UNITED STATES. — The work of several agricultural Stations is almost exclusively that of selecting plants resistant to diseases and adverse weather conditions. Thus the Pomological Station situated near Lake Minnetonka (Minnesota) has produced, by methodically carrying out a continuous series of crossings, some fruit-trees that have a great resistance to low temperatures. Very encouraging results have been obtained for apples and about thousand of the most promising hybrids are being grown in the nursery of the Station. Further, by crossing the Japanese Burbank plum with the American Wolf plum, the same Station was able to fix the characters "resistance to cold", "early maturity", and "fine, tasty fruit" (which are most seedless) in very good proportions in the new hybrid.

Other results that are very interesting from the scientific point of view have been obtained by crossing apricots, peaches and plums; by repeatedly crossing hybrids (plum \times apricot) \times plum with the apricot or peach. Hybrids are obtained that give fruit resembling the apricot and which are very resistant.

Equally important results have been obtained with the vine in a relatively short time. The hybrids Beta \times Concord and Beta \times Brighton, with suitable selection, have given varieties with fruit having the quality of the varieties Concord and Brighton together with the vigour and resistance to cold characteristic of the Beta vine.

At the New York Agricultural Station work has been in progress for years in order to improve the vine and between 1898-1903, at least 1500 hybrids were tested, only 5 being found worthy of notice. Since 1905, in the crossing and selection experiments, possibilities suggested by study of Mendelian laws have been taken into account.

Thanks to the initiative of the Massachusetts Asparagus Growers' Association, a series of experiments were started in 1906 which have led to improve the asparagus considerably (1); some types have been obtained that are completely resistant to *Puccinia Asparagi*.

By crossing the common water-melon, susceptible to *Fusarium nivum*, with an aberrant type, resistant to that fungus, but with non-edible fruit, we obtained intermediary forms in the F_1 ; in the F_2 , a large number of varied combinations; in the F_3 a plant which was isolated not only with atypical water-melon fruit, but also had the resistance to *Fusarium* of the aberrant parent. From this individual was isolated the Conqueror variety with excellent fruit and resistant to *Fusarium*.

On the other hand, the Iron variety of *Vigna Catjang*, resistant to *Fusarium trochiphilum* and *Heterodera radicicola*, was crossed with the Black Whipoorwill varieties by OROON, who obtained some lines uniting the resistance of Iron to the fungus and seed characters of the more valuable parents.

(1) See *R.*, March, 1918, No. 285. (*Id.*)

In the United States, types of gooseberry resistant to *Puccinia Ribis* D. C. (HANSON) have been obtained, as well as potatoes resistant to *Phytophthora infestans* and *Chrysophlyctis endobiotica*, vines resistant to black rot (*Guignardia Bidwellii*) (HERFF) and oats resistant to *Ustilago Avena* (NORTON).

FRANCE. — For a long time numerous crossings have been made, in accordance with a definite programme, between American and European vines in order to obtain disease resistant varieties.

According to CASTEL the hybrids of *Vitis europaea* with *V. Labrusca* give the best results, both against mildew, oidium and blackrot. The hybrid Maurice Baco 22 A (Folle Blanche × Noah) is very productive and resistant to *Botrytis cinerea*. As regards mildew, the following is a list of the most resistant hybrids:

Hybrids with red grapes: Malègue 2094-3; Malègue 2183-3; Baco 1; Juris 3; Gaillard 104; Condere or Coutassot 7120; Condere 106-16; Seibel 873; Seibel 1082; Seibel 1121; Malègue 829-6.

Hybrids with pink grapes: Seibel 2857; Seibel 4464; Malègue 474-5.

Hybrids with white grapes: Seibel 793; Seibel 880; Seibel 2653; Seibel 4645; Seibel 142; Malègue 57-1; Malègue 1157-13; Malègue 1647-8; Malègue 1897-12; Condere 239-1; Condere 272-60; Girard 157.

INDIA (Pusa), AUSTRALIA, NEW ZEALAND. — In these 3 countries, varieties of wheat have been obtained that are resistant to rust, to *Tilletia laevis* Kuhn and *T. tritici* Wtr., and in New Zealand a rust-resistant one (Ruakura Rust Resistant).

EAST INDIES. — After the terrible epidemic of *Hemileia vastatrix* on *Coffea arabica* was replaced by *Coffea liberica* resistant to the disease but giving coffee of inferior quality. By suitably crossing these two species MANES obtained hybrids uniting the valuable qualities of both parents.

On the other hand, KÖBUS obtained good results by crossing the "Tybon" sugarcane, very good, but not resistant to disease, with the Hawaiian variety "Tschun" which, however, is very resistant.

RUSSIA. — Selection for resistant types is carried out at the Saratov Agricultural Station. By crossing the sunflower cultivated in Russia with a Californian variety, STEBUTT and KARSIN obtained varieties resistant to *Homœosoma nebulosella* (1).

520 - Varieties of Egyptian Cotton Produced by Mutation. — KEARNEY, THOMAS H. *The Journal of Heredity*, Vol IX, No. 2, pp. 51-61 + 8 Figs. Washington, February, 1918.

Egyptian cotton is much in demand on the American market for the manufacture of articles requiring a high degree of tensile strength, such as sewing thread, durable hosiery and motor-car tyre fabrics. At the suggestion of the U. S. Department of Agriculture, and under the direction of H. J. WEBBER numerous comparative cultural experiments were begun in 1900 at agricultural stations in the south and south-west, using cottons imported directly from Egypt. These experiments showed that it is possible to cultivate Egyptian cotton in the United States if it is grown

(1) See R., April, 1917, No. 321. (Ed.).

irrigated lands of the south-west. Nevertheless, even under the most favourable conditions the newly-imported varieties produced little, ripened late and varied greatly. This is probably due to the fact that in Egypt cotton fields are often exposed to cross fertilisation with hybrid varieties, particularly with the "Hindi" cotton, which grows wild in the fields.

Careful selection was, therefore, required to obtain earlier, more productive, and more uniform types. Selection experiments begun at Yuma (Arizona) gave very satisfactory results in a few years, involving the improvement and gradual fixing of the desired characters without altering the structure and appearance of the original type, "Mit Afifi".

In 1908 a new era began with the unexpected appearance of two lines obtained by selection differing greatly from the parent stock and from each other. These two lines gave rise to the Yuma and Somerton varieties. The second variety had to be discarded because of its excessive production of sterile branches, but the first became the basis of the Egyptian cotton industry in Arizona. This new variety differs from the Mit Afifi variety in larger and more pointed bolls, and in a longer ($1\frac{1}{2}$ inch) and lighter fibre.

Mr. E. W. HUNSON obtained a third variety, Gila, from a plant selected in 1908 in a field of acclimatized Mit Afifi cotton at Sacaton, Arizona, though differing less from the original stock than the Yuma and Somerton varieties, Gila is sufficiently distinct to be considered as a new variety.

The Yuma, Somerton and Gila varieties are, thus, all derived from the Mit Afifi Egyptian cotton.

In 1910, in a field of Yuma cotton at Sacaton, a specimen was selected and kept separate because of its superior productiveness and length of fibre. From this plant was derived the Pima variety which differed from the Yuma variety in fewer vegetative branches and better developed fruiting branches, by its plumper, more sharply pointed and less deeply pitted bolls, lighter, silkier, and longer ($1\frac{3}{8}$ to $1\frac{3}{4}$ inch) fibre.

The new varieties spread rapidly, especially in the Salt River Valley, where they were grown over ever-increasing areas: — in 1912, Yuma, 200 acres; in 1917, Yuma, 23 000 acres, and Pima, 7 000 acres (a total of 30 000 acres); in 1918 it is estimated that the crop will cover 100 000 acres.

The Yuma and Pima varieties supply first quality material for spinning and for motor tyres. Pima is preferred on account of its earliness and long fibre, and will undoubtedly completely supersede Yuma. It is not easy to solve definitely the problem of the origin of these varieties; certain phenomena point to roguing, whereas others point rather to true mutation.

I. — ROGUING. — 1) Mit Afifi cotton probably originated towards the middle of the 19th century from hybridization of Sea Island with a brown seeded African tree cotton; 2) as has been already stated, Egyptian cotton fields are frequently exposed to cross-fertilisation. Consequently the presence of many heterozygous characters would explain the frequent appearance of rogues.

II. — MUTATION. — The following phenomena, however, are in favour of the mutation hypothesis: 1) the sudden appearance and fixation of the new types; 2) the total absence of forms intermediate to the original and new types; 3) the differential characters of the new type, which are entirely

new and of which no trace is found in the species or varieties of cotton which are likely at any time to have come in contact with *Mit Afri*.

521 — **Variations in Eucalyptus Trees in Plantations; Eucalyptus Hybrids Observed Chiefly in Algeria.** — TRABUT, J. (Professor of the University of Algiers, Director of the Botanical Service of the General Government of Algeria), in *Bulletin de la Section de Recherches Forestières du Nord de l'Afrique*, Vol. I, Pt. 5, pp. 140-155 + 6 Figs. + 6 Table Algiers, 1917.

Eucalyptus trees were introduced into France towards 1854 and, since 1862 plantations have been made in Algeria. In 1876 a private collection started in 1864, contained 10 000 trees belonging to 120 species, all of which did more or less well.

The author's observations and propagation experiments show that in Algeria, the eucalyptus trees contained in collections may be crossed with the greatest ease. This is very valuable knowledge from a practical point of view because hybrid plants are stronger and better suited to the climate than the stock from which they are derived. For this reason there is no doubt that plantations should be formed with such hybrids.

After artificial hybridisation, which will give important practical and scientific results, has been carried out, the cultivation of the eucalyptus tree will become essential in the Mediterranean district, where it renders extremely valuable services.

522 — **The Production of Forage Plant Seeds in Denmark.** — *Statistiske Entretninger*, Year, X, No. 1, pp. 5-6. Copenhagen, January 23, 1918.

The extraordinary rise in the price of forage plant seeds has caused Denmark a considerable increase in the area cultivated for the production of such seed; this is shown by the following figures:—

Area cultivated for the production of forage plant seeds in Denmark.

Seed	July, 1917 acres	December 5, 1917 acres
Roots:—		
Swede	2 528.6	7 125.0
Turnip	1 875.5	12 490.1
Carrot	1 487.1	5 042.2
Forage Leguminosae:		
Clover, alfalfa, etc.	2 210.8	1 513.0
Forage grasses:—		
Cocksfoot	18 265.6	22 502.3
Meadow fescue	2 993.5	3 585.0
English ray-grass	5 751.0	2 866.5
Italian ray-grass	2 012.0	4 222.9
Field brome grass	3 199.3	7 028.0
Other forage grasses	2 012.0	1 476.5
Total	40 323.4	67 851.5

It is seen that the increase in seed production for root crops is considerable, whereas that for grasses only forms about 30 % of the total.

[520-522]

- 323 — **The Identification of Varieties of Barley.** — HARLAN, HARRY V., in *United States Department of Agriculture, Bulletin No. 622*, 32 pp. + 4 Plates, Bibliography of 41 publications. Washington, 1918.

CEREAL
AND PULS
CROPS

The variations that occur in barley are of importance to the student agronomist, plant breeder, and pathologist. They offer a wide opportunity for selection, breeding, and study of disease resistance. In barley the forms are unusually numerous and clearly defined. The number and character of the types existing are more concisely indicated by a classification of variations than in any other way. The groups of barley were arranged upon the basis of species, varieties, and sub-varieties. Only major characters have been used in describing species and varieties; less important characters have been utilized in describing sub-varieties. Under each sub-variety there may be an unlimited number of agronomic varieties. Four species and 32 varieties are recognized as follows: — *Hordeum vulgare* with the varieties: *pallidum*; *nigrum*; *Horsfordianum*; *atrum*; *coeleste*; *duplicatum*; *trifurcatum*; *aethiops*; *H. intermedium* with the varieties: *Haxtoni*; *Mortoni*; *subcornutum*; *alricornutum*; *nudi-haxtoni*; *nudi-mortoni*; *cornutum*; *subaethiops*; *H. distichon* with the varieties: *palmella*; *nigricans*; *angustispicatum*; *Rimpawi*; *nudum*; *nigrinudum*; *laxum*; *nigrilaxum*; *H. deficiens* with the varieties: *deficiens Steudelii*; *tricerus*; *tridax*; *nudi-deficiens*; *desortocatum*; *sublaxum*; *gymnospermum*.

All groups have been made to conform with previous usage as far as possible. One of the principal aims of the writer has been to state clearly the form or group intended to be described by each published name. Except for their historical significance, the sub-varieties would not have been continued, and no forms have been added to them.

Four varieties have been added.

Lists of rejected terms and varieties are included.

The keys can be adapted to the identification of thrashed grain by a number of characters. In the common agronomic varieties the chance of error in the identification of thrashed grain is slight.

- 324 — **Sorghums for Forage in South Dakota.** — CHAMPLIN, MANLEY and WINBRIGHT, GEORGE, in *Agricultural Experiment Station, South Dakota State College of Agriculture and Mechanic Arts, Bulletin No. 174*, pp. 624-645, 9 Tables, 15 Figs. Brookings, S. Dak., March, 1917.

FORAGE CRO
MEADOWS
AND PASTUR

Sorghum is commonly used for forage in South Dakota. In the United States, three fourths of the total herbage produced by all sorghums is consumed as coarse forage. The most promising forage sorghums are the black and red seeded amber canes and Sudan grass. Dwarf milo, feterita, kafir, shallu and others are also grown in some localities.

This bulletin gives the results of comparative trials of the producing power of these crops and directions for growing the crop based on the writers' experience at the South Dakota Experiment Station farms at Brookings, Cottonwood, Eureka, Highmore and Vivian. They are summarized as follows: —

Sorghum as a forage crop is worth considering carefully in South Dakota because it matures quickly, yields fairly well and is adapted to

hot weather and limited moisture conditions; it may thus be used as a cold crop. Sorghum as a forage crop is not superior to maize in seasons that are reasonably favourable to maize.

Several difficulties are encountered in growing sorghum on account of the small seed, danger of planting too deep and the slow growth of the young plants.

Variety tests of sorghums in South Dakota indicate that Sudan grass is best for hay, the amber canes for coarse fodder and dwarf milo for silage. The average yields of fodder as compared with maize in variety tests at Brookings in 1914-1916 were as follows:—

Crop	Yield in lbs. per acre
Minnesota Amber.	5 110
Sudan	4 580
White Amber	4 000
Freed Sorgo	3 680
Dakota Amber.	3 650
Kaoliang.	3 300
Dwarf White Kalir.	3 220
Péterita	2 500
Kaferita	2 000
Brookings 13, Maize.	6 637

The soil preparation necessary for maize is sufficient for sorghum.

Where moisture is plentiful Sudan grass gives the best results drilled in 6 or 12-inch rows. It can be used as an intertilled crop if desired.

All varieties of sorghum except Sudan grass gave the best results in method of seeding tests when drilled in rows 36 or 42 inches apart and cultivated.

In date of seeding experiments Sudan grass gave best results when seeded between May 20th and June 1st. It is safe to assume that the dates are also best for the amber canes and dwarf milo, as these sorghums have practically the same temperature requirements.

Head selection should be practiced in securing sorghum seed.

Sorghum drilled in 36 or 42-inch rows may be harvested with an ordinary corn binder. Shocks must be built small.

Sorghum drilled in 6 or 12-inch rows or sown broadcast may be harvested with a mower or grain binder.

525 - *Medicago falcata*, a Yellow-Flowered Alfalfa. (1). — OAKLEY R. A. and GARVER, SAMUEL, in *United States Department of Agriculture, Bulletin No. 428*, pp. 79 Tables, 23 Fig., Bibliography of 67 publications. Washington, 1917.

The first recorded importation of *Medicago falcata* in the United States was made in 1897. The first systematic introductions for the purpose of utilizing the species as a cultivated forage crop were made in 1900 by Prof. N. E. HANSEN under the auspices of the U. S. Department of Agriculture. Since that date many lots of seed representing various forms of the species have been introduced by Prof. HANSEN, Mr. F. N. MEYER

(1) See also R., 1917, No. 333. (Ed.)

and various others. Approximately fifty lots have been introduced, mostly from Russia and Siberia.

At the present time *Medicago falcata* is found growing without cultivation in most parts of Europe and the western two-thirds of Asia. Over a large portion of this area it is probably indigenous. It is found throughout a wide range of soil and climatic conditions and at depressions and elevations ranging from below sea level to 13 000 feet above. It is much wider in its adaptations than *Medicago sativa*.

The species was recognized by botanists early in the history of modern botany, if not long before. Recent botanists differ somewhat with regard to its taxonomic relationship to *Medicago sativa*. Some give it the rank of a true species, while others regard it as a variety or subspecies of the latter. The natural relationship of the two, however, is quite clearly shown by the readiness with which they hybridize and the fertility of their hybrids.

It is an extremely variable species, many forms of which are difficult to classify satisfactorily on account of their varying combinations of characters and the difficulty of determining whether they are of pure or hybrid origin. A classification or grouping has been attempted in this paper largely upon the basis of habit of growth. Four groups have been established, ranging in habit from prostrate to almost erect. The first two are referred to as pasture groups, as they are not sufficiently erect to be harvested satisfactorily for hay by machinery. The last two are sufficiently erect to be harvested for hay and are referred to as hay groups.

Botanists have named and described several of the species, many of which have proved to be hybrids of *Medicago falcata* and *Medicago sativa*.

Medicago falcata has never been extensively cultivated in Europe or Asia, although it has been utilized as a wild forage plant since a very early date. Many attempts have been made to cultivate it in Europe, but so far as can be found it is now being cultivated only in India and, possibly, to a very limited extent in south-eastern Russia and Chinese Turkestan.

The erect forms of *Medicago falcata* closely resemble those of *Medicago sativa* in their mass effect, but on an average they produce a heavier yield in comparison with their bulk, partly because of the more numerous stems and partly because of the texture of their herbage. Under similar conditions of soil and stand of plants the best strains of *Medicago falcata* frequently outyield the best varieties of *Medicago sativa* for the first cutting of the season.

A very serious drawback to the general utilization of *Medicago falcata* as a cultivated forage crop is its inability to recover quickly after cutting. Under conditions such as exist in the West and Northwest, where it appears to offer its greatest possibilities, it can be depended upon to make only one crop in a season. It produces seed sparingly and does not hold it as retentively as does *Medicago sativa*. This is also a serious handicap to its use as a cultivated crop.

The natural range of distribution of the species, its adaptations, and its behaviour under field conditions in the United States warrant the conclusion that it is relatively hardy and drought resistant.

Chemical analyses and general feeding tests indicate that it is approximately as valuable from a feeding standpoint as common alfalfa.

The cultural requirements of *Medicago falcata* appear to be much the same as those of *Medicago sativa*. On account of the hard seed which the former produces and the slow growth of the young plants it is difficult to secure a satisfactory stand from seeding, either broadcast or in rows. When grown in broadcast stands the procumbent forms are inclined to be more nearly erect than when grown in rows or hills. The plants of this species bear transplanting better than do those of *Medicago sativa*.

Data from broadcast plants of *Medicago falcata* and *Medicago sativa* indicate that in seasons when only one cutting of the latter can be procured the former produces the heavier yield, but in favourable seasons, when two or more cuttings can be procured, the latter excels appreciably in yield.

Sowings of *Medicago falcata* have been made on unbroken native soil and a fair stand of plants secured. The plants appear to lack sufficient aggressiveness to make them really valuable under such conditions.

The greatest possibilities offered by the species appear to be in the field of selection and hybridization. In a few cases it is probable that the development of promising pure strains by selection will prove to be advantageous. As the result of hybridizing with *Medicago sativa* and subsequent selection it is believed that superior varieties of alfalfa can be developed and that the greatest value of the species is for this purpose.

Much time and effort will be required before *Medicago falcata* will be ready for general cultivation.

526 - Cultivation of the Castor-Oil Plant in North Africa. — COUSTON, F., in *Journal d'Agriculture pratique*, New Series, Vol. XXXI, No. 3, pp. 45-47, February 7, 1918; No. 4, pp. 71-73, February 20, 1918; No. 5, pp. 94-95, March 7, 1918. Paris.

The castor-oil plant grows abundantly in many ravines on the North African coast. The severe winters prevent its growing in the Upper Table Lands and in the Atlas Mountains, but it re-appears in the Sahara zone and is found in many oases where it was originally imported as an ornamental shrub. The author has observed it from the Biskra district (foot of the Atlas) to Aïn-Salah and Aoulef, more than 600 miles further south, in the midst of the Sahara.

The castor-oil plant is perennial. It is injured by hard frosts and prolonged cold, and requires much water in summer, when its growth is most active. It would do well all along the coast, and in the south in the Sahara district, wherever it is assured of sufficient moisture during the summer growing period. In its climatic and cultural requirements it resembles cotton in North Africa the castor-oil plants thrive wherever the cotton-plant does well. It seems to withstand slightly more cold than cotton.

The variety chosen should have the following characters: — abundant yield of well-filled seed; fruit ripening as much as possible at one time; in particular, *moderately dehiscent* capsules; varieties the indehiscent fruit of which require excessive threshing and husking should be rejected, as well as those the capsules of which open suddenly when ripe, often casting the seed a distance of some yards.

The Marseilles industry, consulted in 1917 by the Administration of the South Algerian Territories on the varieties most suited to the manufacture of oil, replied that the various samples of castor-oil seed received at different times from Algeria were perfectly suitable. As this industry chiefly uses seed from India, mostly from Bombay, the General Government of Algeria obtained at Marseilles, seed from Bombay (of the ordinary small castor oil plant = *Ricinus communis minor*) for free distribution. According to Dr. TRABUT, this plant is the one best suited to the dry Algerian climate from the point of view of dehiscence of the capsules.

The author then discusses the systematic cultivation of the castor-oil plant and the planting of uncultivated land moist in summer (bottom of ravines, banks of canals, irrigated gardens and oases, beds or banks of "oueds", ditches, railway embankments, etc.), and draws attention to the uses of the castor-oil plant and its by-products. Finally the necessity for establishing castor-oil factories in Algeria is pointed out.

27 - Rubber in North Borneo. — *The Tropical Agriculturist*, Vol. XLIX, No. 4, pp. 197-200. Peradeniya, Ceylon, October, 1917.

The area planted with rubber at the end of 1916, according to returns received from managers of estates was 30 910 acres. Small holdings planted by Chinese and natives are not included in these figures. The amount of new land planted during the year, was only 529 acres. The number of trees in tapping at the end of the year was 2 030 150 or a little over half the total number planted, which is returned at 4 049 050. The area in full tapping was 14 720 acres as against 9 806 acres at the end of the previous year.

According to the figures supplied by the Customs Department the export in 1916 was 1937.7 tons, an increase of 84.4 per cent. on the total of 1050 tons shipped in 1915. In January the price of smoked sheet reached £ 2d. but dropped quickly to about 3s. 6d.; it then declined steadily until August, when it had fallen to 2s. 1 1/2d., after which it rose to about 3s. 0d. in December.

The extension of tapping operations necessitated an increase in the labour force at most estates. At the end of the year the total number of coolies employed was 12 334, an increase of 2 698 over last year's total. Whereas in 1915 one coolie was sufficient for three acres, in 1916 the average was one for 2.5 acres. Of the coolies 5 179 were Chinese and 4 280 Javanese; 875 belonged to other races, all but a few being natives of North Borneo.

The rainfall in 1916 was heavier than in the previous year. Estates in the West Coast had an average of 165 inches of rain in 199 days, in the interior 66 inches on 202 days, in the Kudat residency 89 inches on 176 days, in the Sandakan residency 133 inches on 212 days, and in the East Coast residency 95 inches on 130 days. On no estate was there a single month entirely without rain.

RUBBER, GU.
AND
RESIN PLANT
ETC.

moisture ; again, the colour shade of the foliage is a type character of the different varieties of beet.

It appears to result from a series of observations and determinations carried out over several years on 2 descendants of sugar beets, one with light-coloured leaves, the other with dark leaves, the other conditions (soil, manuring, etc.) remaining the same, that a dark green leaf contains more nitrogen than a light green leaf, so that there would be a direct relation between the colour of the leaves and the corresponding nitrogen content. On the other hand, light-coloured foliage does not always indicate early maturity or a high sugar content in the roots ; there may be beets with light coloured leaves that are early and richer in sugar, but the contrary may also happen. In experiments lasting 2 years, the progeny with dark leaves yielded better and produced more sugar than the light-leaved ones ; they form sugar very rapidly in late autumn.

In 1 year experiments, analysis showed that the darkest leaves contained more potash and less soda, but this observation, based on one case only, can not be applied generally. It seems rather that there is a certain relation between the highest potash content of the leaves and the greatest sugar content of the roots. Both in beets with light coloured foliage and those with dark leaves, the potash rapidly increases in the leaves, while the soda content decreases as the beets mature.

IV. — INFLUENCE OF SELECTION ON THE VALUE OF BEETS. — The analytical data collected each year by the various Czech Sugar Associations give an idea of the averages for 20 years as regards Bohemia : —

Periods	Sugar Content	Weight per beet, in gm			Percentage of foliage in relation to the root
		Root	Sugar	Foliage	
1897-1901	14.88 %	354	52	244	69 %
1902-1906	16.4 "	355	58	239	67 "
1907-1911	16.8 "	374	63	268	72 "
1912-1916	17.6 "	467	82	332	82 "

These figures clearly show the influence of selecting beets on the value of their yield. It may be said, it is true, that the higher yield of the modern beet varieties is due to better cultivation and heavier applications of manure and fertilizer ; but that does not weaken the influence of selection on the increased yield ; in fact, the new high-yielding varieties allow of heavy manuring, especially nitrogenous, which could not have been used previously because the commercial value of the beets would have so been affected that the extraction of the sugar would not have been sufficiently profitable. The present varieties, owing to their higher yield, not only allow of heavier manuring, but even require it their yielding powers are to be fully utilised.

It should be noted that the increased yield of the various sugar beet varieties is accompanied, both absolutely as well as relatively, by an increase in the quantity of foliage produced ; as the dry matter content has

also increased and as it is well known that beet leaves make excellent fodder, the new beet varieties have the advantage of producing a better quality and greater quantity of fodder than the old ones.

The lack of terms of comparison and the influence of meteorological factors may nullify these conclusions, but the mass of data, the extent of the determinations and the long period of years compensate the disturbing influence of these factors so as to show up still more the effect of selection.

529 - **Experiments on the Catalytic Fertilisation of Seed Sugar Beets with Manganese Sulphate in Austria.** — GREISENEGGER, J. K. (Mitteilung der Chemisch-technischen Versuchs-Station des Zentralvereines für die Rübenzucker-Industrie), in *Oesterreichisch-Ungarische Zeitschrift für Zuckerindustrie und Landwirtschaft*, Year XLVI. Pt. 1-2, pp. 13-21. Vienna, 1917.

In view of the importance and uncertainty of the influence of manganese on plants, especially sugar beets, the author undertook an investigation not only into beets grown for fodder (1), but also into second year seed beets.

To 15 pots containing sand and peat were added 24 litres of KNOP's nutritive solution and manganese in the form of sulphate in amounts equivalent to 22.3 lb. per acre to 5 pots and four times the quantity to 5 others; the remaining 5 pots were used as controls.

Although the smaller quantity had no *obvious* effect on the seed yield it had a reflex action in that it increased slightly the sugar content of the beets obtained from the seeds. The larger quantity of manganese markedly increased the production of seeds, but the beets obtained from them weighed less and contained less sugar.

In using manganese fertiliser a deceptive amount must not be applied. Many further experiments are necessary to determine if the limit is the same for all seasons and all varieties of beets.

530 - **Cacao in the Dominican Republic.** — MC LEAN, A., in *Commerce Reports*, No. 284, pp. 876-877. Washington, D. C., 1917.

Cacao is, after sugar, the leading export of the Dominican Republic. The Spaniards introduced cacao in the Dominican Republic from Venezuela in the early part of the 18th century, but it is only within the past 25 years that the tree has been cultivated extensively. The Provinces of La Vega, Samana, Espaillat, and Pacificador, in the northeastern section of the island, lead in the production of cacao in the Dominican Republic, but no statistics are available as to the total area planted.

Native methods of cultivating and preparing cacao for market are primitive and unsatisfactory. Almost all of the cacao is grown on small farms, and there are few large and scientifically managed plantations. These farms are mainly owned by Dominicans and are cultivated by labourers of the same nationality. Farm labourers receive from 50 to 60 cents a day, with a small shack and a patch of land to cultivate for themselves. There is no agricultural school nor experiment farm in the Dominican Republic.

(1) See R. 1916, No. 52. (Ed.)

although both are badly needed in order to teach the people how to obtain the best results from their lands through the use of modern and scientific methods of cultivation.

The cost of land suitable for the cultivation of cacao in this Republic varies greatly, depending largely on its fertility and accessibility. The rich, alluvial lands in the humid and well-watered regions within easy reach of the Samana & Santiago Railroad and Samana Bay are considered the most desirable. Such lands are held at \$ 60 to \$ 75 an acre uncleared and at \$ 75 to \$ 90 cleared, the cost of clearing being from \$ 12 to \$ 18 an acre. The value of the lumber on the lands, which sometimes includes cedar and mahogany, would more than pay for the clearing but it is burned for lack of sawmills and means of transportation. Lands with bearing-cacao trees are valued at \$ 120 to \$ 150 an acre, with a rising tendency.

The cacao seeds in this island are planted directly in their permanent position in the field and not in nurseries as in some other countries. The seeds are planted in October to take advantage of the winter rains. Several seeds are usually planted together and when the seedlings are a year old the strongest are left to mature and the weakest destroyed. As a rule about 100 trees to the acre are left.

The variety of cacao planted most frequently in this Republic is known as "calabacillo", which bears small yellow pods with flat beans. The varieties known as "forastero" and "criollo" are also planted, but to a much less extent than the "calabacillo".

While the small plants are growing corn, yucca, bananas and plantains are planted between them, primarily for shade, but also to afford some return while the cacao is maturing. As the cacao trees grow larger amapola trees are planted to give them shade. The ground between the cacao trees is cleared with hoes and machetes, as ploughs are rarely used in the Dominican Republic. No windbreaks are used to protect the growing plants, nor is there any system of drainage on the plantations. As the lands on the coast are very rich, the Dominicans have not as yet begun to use fertilizers.

The cacao trees begin to bear the fourth or fifth year, when they yield from one-half to 1 ½ lb. From about the seventh until the twenty-fifth year they are at their best, yielding as high as 3 ½ to 4 lb. per tree on the most fertile lands. Cacao trees have been known to live for more than 100 years, but they seldom bear after the sixtieth year. The trees are pruned every year, usually after the harvest.

The aphid and a number of other insects attack the cacao trees. It is said that these pests may be exterminated by merely spraying the trees with a solution containing refined petroleum, yet growers rarely make any attempt to get rid of them.

Cacao is usually transported from the farms to the towns on mule or pack, as the roads are as yet impassable for carts and wagons. The principal towns in the cacao growing region — Moca, Salcedo, La Vega, San Francisco de Macoris — are connected by railroad with the port of Sanchez, whence steamers sail fortnightly for New York. Cacao in this

market is usually packed in jute sacks, weighing 65 kg. net and 66½ gross. Prior to the war the freight was 45 cents per 100 pounds from Sanchez to New York, although at present it is exactly double that figure.

In the past five years cacao has been shipped from the Dominican Republic as follows.

Cacao exported from the Dominican Republic, 1912-1915.

Year	Kg.	\$
1912	20 832 602	4 248 724
1913	19 470 827	4 119 955
1914	20 744 517	3 896 489
1915	20 223 023	4 863 754
1916	21 053 305	5 958 659

In 1916, 22 249 540 kg. of cacao were shipped into the port of New York from the Dominican Republic. That was a greater quantity than from any other country. The next largest importations of cacao at New York during 1916 were 20 266 313 kg. from Ecuador, 15 895 710 from Trinidad, and 14 471 783 kg. from Brazil.

Cacao from the Republic is known as "Sanchez" on the world markets. The cacao is bought up from the growers by the local exporters who make them advances on their crops. The exporters usually ship the cacao to New York commission houses on consignment.

Despite the fact that it is one of the great cacao producing countries of the world, little or no chocolate or confectionery is manufactured in the Dominican Republic; practically all that is consumed is imported.

531 - **Hop-Growing in Galicia, Spain.** — I. ROBBEDO, L. H., in *El Progreso agrario pecuario*, Year XXIII, No. 1036, pp. 506-507. Madrid, November 22, 1917; *El Cultivador Moderno*, Year VII, No. 2, pp. 11-12, 3 Figs. Barcelona, February, 1918.

At the present time there are in Spain about 20 breweries using, on average, 196½ cwt. of hops annually. The price of hops varies greatly. In Spain, in 1912, the average price was 4s. 4d per pound; in 1916, American hops fetched 1s. 3d. per pound, and German hops, 1s. 9½d. per pound. The hops used by the author at the Agricultural Station of Corunna in 1917 cost 1s. 11½d. per pound.

As hops grow wild in Galicia, the author introduced from England in 1915, the varieties Golding, "dorado de Inglaterra", white, and green, and cultivated them at the Corunna Station. The deep, sandy soil, rich in humus, was given 16 tons of manure per acre, and was ploughed to a depth of 16 in. Cuttings were planted about 5½ feet apart in squares. At the beginning of May the scarifier was used once, and the land tilled lightly. The harvest was in mid-September. The hops were dried in the sun on frames one above the other, with a distance of about 8 inches between each one. At the end of October the plants were cut down to about 12 inches above the ground. The highest yield in 1916 was obtained from the variety "dorado de Inglaterra", which gave 28.61 cwt. per acre of green fruit, corresponding to 9.16 cwt. of dried fruit. This is an excellent re-

pecially considering that it was obtained in the second year of cultivation, that is to say, before the plants had attained their maximum yield. The quality was excellent. The cost of cultivation amounted to £ 2.17.9 pence.

- **Results Obtained in Italy from the Sowing of Wild-Fig Seed.** -- LONGO, B., in *Atti della Reale Accademia dei Lincei*; Series V, *Rendiconti*, Vol. XXVII, Pt. 1, 1st. Half-year, pp. 55-57. Rome, January 6, 1918.

M. CAVOLINI, M. GASPARRINI, and the author in Italy, and M. LECLERC SABLON in France, have shown that *Ficus Carica*, both when wild and when cultivated, occurs in two forms -- the ordinary fig and wild-fig. It has been shown experimentally, first by M. GASPARRINI, then by M. CAVOLINI, that if the fig (*i. e.*, the small fruit of the second figs) is sown, the ordinary and the wild-fig are obtained. It remained to show what would be obtained by sowing the few small fruits found between the galls of the second year of the wild-fig tree. In 1912, the author sowed both wild and cultivated wild-fig seed; the plants obtained began to bear fruit in 1917, and proved to be partly ordinary figs, partly wild-figs. The seed of wild-fig, like those of the ordinary fig, thus gave both types of plant.

- **The Native Bananas of the Hawaiian Islands.** -- MACCAUGHEY, VAUGHAN (College of Hawaii, Honolulu), in *The Plant World*, Vol. XXI, No. 1, pp. 1-12. Baltimore, January, 1918.

As amongst all the Polynesian peoples, the banana was an important article of food amongst the ancient Hawaiians, and all explorers mention its abundance round the settlements. This profusion was doubtless due to the ease with which the plant is propagated, the little attention needed to cultivate it, its great productivity, perennial character, and its nutritious and palatable fruit. The decrease in the native population lowered the value of the banana as a food. As its cultivation gradually increased again, foreign varieties (chiefly the Chinese variety) were imported from time to time and superseded the native varieties both in the plantations and on the market. Among the imported foreign varieties are: --

Musa Cavendishii, a Chinese banana introduced from Tahiti about 1855; it is the most important and widely-grown commercial variety and there are extensive plantations of it in Honolulu; the local consumption is large and considerable quantities are exported to foreign ports; owing to its dwarf size and deep roots it suffers less from storms than the other varieties.

Musa Fehi, also imported from Tahiti; the stem of the bunch is erect instead of hanging down as is the case with most bananas; the fruit is of fair quality when cooked.

The Brazilian banana was also imported from Tahiti about 1855; it reaches a height of 25 to 35 feet; it is firm-rooted and is often used as a windbreak for more fragile trees; the fruit is of excellent flavour, slightly acid.

Other foreign varieties are Bluefields, Ice Cream, Apple, Lady Finger and Abaca, or Mahoe (*Musa textilis*).

The cultivation of the native varieties is beginning to develop in all plantations. All the native varieties, of which the author describes 22, derived from *Musa sapientum*. They may be divided into three groups,

FRUIT
GROWING

each belonging to one of three dominant types, known locally as *Maoli*, *Iho-lena* and *Po-po-ulu*.

All the native varieties are seedless and could only have been introduced into the islands by human agency; the roots and "suckers" are quickly killed by sea-water, and could, therefore, not have been carried by ocean currents as is the case with many seeds with impervious tegument. The banana, with other plants and animals must have been imported by the Hawaiians when they immigrated. The first villages were along the coasts and the primitive agriculture of the native naturally developed in the near valleys and lowlands rather than in the mountainous districts of the interior. However, as the rainfall in the plains was not sufficient to satisfy the requirements of the plant, which needs much moisture, the banana plantations gradually spread along the wet upper valleys, where the plant was also sheltered from the strong winds, and the inland rain-forests. The banana does not suffer from shade, and coolness does not seriously retard the ripening of the fruits.

It thus happened that most of the groves were at some distance, often several miles, from the villages. The plants propagated spontaneously and when the native population declined, formed practically wild groves wild in the sense that they have escaped from cultivation, but they are not indigenous.

Banana groves are sometimes found at heights of 3 500 to 4 500 feet. The plants are usually dwarfed and produce little, and the fruit rarely ripens, being eaten by rats before it reaches maturity, which is considerably retarded by the cold.

The banana trunk may reach a diameter of 3 or 4 feet. It emits numerous shoots by which the plant may be indefinitely propagated. The plants are easily uprooted, and, in rainy districts, are often torn up by mountain streams which carry them some distance till they lodge in suitable crevasse, where they root take and sprout again.

All these varieties are, therefore, easily transplanted, and many private groves in Honolulu contain plants collected from the mountain districts of the interior and from the other islands. For transplanting a sucker or offshoot 2 or 3 feet tall is generally taken. This is carefully separated from the parent plant so as not to injure its base, and planted in mellow soil with about half of the shoot underground. It grows rapidly and bears fruit 10 or 15 months later. The ancient natives used the fibre from the leaf-sheaths as a textile, but since the introduction of cheap cotton thread its use has gradually died out. The tissues of the plant contain a watery latex which turns dark brown or black when exposed to the air, and was used by the Hawaiians to stain their household utensils, gourds, etc.

Many of the native varieties are only edible after having been cooked; these are known as "cooking bananas". Heat changes the starches into sugars and the flesh of the fruit is saturated with a delicious sugary syrup. The cooking bananas are also largely used by the white settlers; they fetch a good price and their popularity is bound to increase as their food value becomes better known.

The native Hawaiian banana has, then, re-won its position as a food. The author believes the best varieties will be put on the market in increasing numbers and will finally become one of the most important exports of the Pacific Islands. There is no reason why it should not become an important crop in America with a commercial development similar to that of the pineapple.

The Mango in Porto Rico. — KINMAN, C. F., in *Porto Rico Agricultural Experiment Station. Bulletin No. 24*, pp. 37, 2 Tables + XI Figs. Washington, 1918.

These observations are drawn from the work of several years during which trees of many varieties have been imported, propagated and in some cases brought into satisfactory production.

The common mango of Porto Rico, which is one of the most important fruits of the island, is not cultivated but grows wild in all localities. Superior varieties lately imported have proved satisfactory and should be planted extensively for market and home use.

Mango trees are adapted to a wide range of soil types and will grow satisfactorily in practically all Porto Rican soils, provided there is a good drainage.

While the climate throughout the island is suitable for the growth of mango trees, in some localities, notably through the interior and along the northern slopes, rains are sometimes too frequent during the blossoming season to permit the setting of a good crop of fruit. Along the western and northern lowlands rainfall is light during the blossoming season and good crops are almost invariably secured.

As the prevailing winds and morning sun seem to be very beneficial, both for growth of trees and setting of fruit, open, exposed sites should be selected for the mango orchard.

Inarching and bark grafting are satisfactory both for use in the nursery and for topworking large trees.

Large seeds which produce only one plant are most satisfactory for nurseries. The East Indian varieties produce larger and more thrifty plants, as a rule, than the native kinds. Both nursery and other mango trees may be transplanted successfully if they are not making a new growth and rainfall is plentiful.

The present confusion in the classification of types of mangoes, as well as the great variation in growth and productiveness of trees, and quality of fruit, necessitates a thorough study of varieties before a mango orchard can be successfully planted in Porto Rico.

Among a number of imported varieties that have fruited there, the most productive of the thrifty kinds with fruits of high quality are Cambodiana, Kafari, Amini, Bennett, and Paheri. Cambodiana and Paheri are obviously better suited to home than to commercial use.

The trees of the few varieties from Martinique, Trinidad, and South America thus far tested lack vigour, while the fruits are either inferior in quality or too small to be promising for general planting. As regards size, flavour, fibre content, and keeping quality, the wild Porto Rican mangoes are less desirable than many imported kinds.

In harvesting mangoes that have not softened on the tree, a stay longer than the fruit stalk should be left to prevent the juice from the base of the fruit from escaping through the fruit stalk and leaving passages to the entrance of infection.

Fruits in orange wrapping paper did not ripen or decay so quickly as those wrapped in oil paper, newspaper, or coconut fibre, or those left in the open air. Fruits packed in coconut fibre ripened earliest. East Indian varieties showed much better keeping qualities than the native kinds.

The mango is one of the most satisfactory ornamental trees for Porto Rico, as variations in habit of growth and colour of foliage make it possible to select from varieties producing fruit of high quality those which best carry out a particular scheme of landscape gardening.

535 — **Direct Bearers: I. In the Department of the Isère; II. In the Department of the Loire (France).** — I. CAILLE, L. and ROUGIER, L., in the *Revue de Viticulture*, 1918, Vol. XLVIII, No. 1230. Paris, March 28, 1918. — II. BLANCARD, *Ibid.*, No. 1231, pp. 218-221. April 4, 1918.

I. — In a report on his experimental field of direct bearers, M. CAILLE, Professor of Agriculture at Vienne, Isère, states that the vines best suited to that district are: —

a) *Vines with coloured grapes*: — Gaillard No. 2 for earliness and seedlessness; Seibel 41, 47, 1000, 1020, 2007, Couderc 106-46 for satisfactory ripening.

b) *Vines with white grapes*: — Castel 1028, Couderc 272-60, Seibel 880, Bertille Seyve 450.

To these might perhaps be added Prof. C. 221, which is very strong, ripens somewhat late; it should be pruned long. Without Prof. C. 221, I makes 11 varieties of obviously varying value. As a rule they all yield regularly and are worth testing. They are, however, not all equally fertile. Castel 1028, Seibel 2007 and 1020, and Couderc 106-46 appear to give the best crops. At the Vienne experiment field two applications of neutral sub-acetate of copper are given, one before flowering and the other immediately after.

To this information Mr. ROUGIER, Director of the Agricultural Service of the Isère, adds a few remarks applying more especially to the south-east of the department. In places where French vines are exposed to frost in winter the use of winter frost-resistant hybrid direct bearers is essential. Among such hybrids are Seibel Nos. 1, 28, 156, 100, Gaillard 157 (white) and 2 (red), and Couderc 4401. The last is more especially suited to clay soils of the plains.

II. — The author (Agricultural Engineer, Director of the Agricultural Service of the Loire) mentions the hybrids which would probably prove of value in the Department of the Loire. As a rule these are early plantings or those of the first period, though in the warm districts of the Loire some later varieties could be grown. These plants, moreover, give produce free from foxy taint.

A) **RIPARIA HYBRIDS.** — The fruit of some of them is large, and the wine is generally good. The bunches are high on the branches, thus requiring the use of wire or props. They are resistant to phylloxera (Riparia

fluence), very vigorous and develop their branches with great rapidity. Flowering is very rapid thus protecting them against vine moths and non-setting.

Black. — Couderc No. 1 or Pinaud-Couderc, 633 H., Oberlin 595, 604 and 605.

B) *RUPESTRIS HYBRIDS.* — The most widely used are *Rupestris*, *Linceum*, *Vinifera*. They are generally productive and give good wine. They are very resistant to mildew. The bunches are borne low on the branches. They may be pruned low or spur pruned without props, nevertheless it is always preferable to put in stakes.

Black. — Couderc 7, 8, 7106, 7120, 4401 (the L. Buffet selection of which has very large fruit); Seibel 1000, 2859, 4643.

White. — Couderc 117-3, 272-60; Seibel 880, 4681.

C) *COMPLEX HYBRIDS.* — *Black.* — Bertille-Seyve 872, 822.

White. — Bertille-Seyve 450; Noah (B. S. 450 is a Noah crossed with Seibel 2003).

D) *OTHER HYBRIDS.* — Gaillard 2 (black), 157 (white); Fournié (Pinaud-Rupestris-blue Portugais), Poirier 19 637.

6- *The Red Spruce: Its Growth and Management in the United States.* — MURPHY, L. S., in the U. S. Department of Agriculture, Bulletin No. 541, p. 100 + Plates I-VII. Washington, October 31, 1917.

FORESTRY

Red spruce (*Picea rubens* Sarg.) is one of the most important woods of the north-east of the United States, where it is found in pure or nearly pure stands. It is used more than any other wood in the manufacture of paper and supplies a large amount of lumber and other material. Of the 116 500 million feet board measure of standing spruce timber in the United States (1% of the total timber), 48.3 % is composed of red spruce, 30.3 % of the Rocky Mountain or Engelmann spruce, and 21.4 % of the Sitka spruce. These figures concern the districts where this timber is of commercial importance; white spruce, black spruce, Colorado blue spruce and *P. Breweriana* Watts occur also.

The most important by-products of red spruce are the resin, used as chewing gum, and the extract from the tender tips of the branches which forms the basis of spruce beer, a non-alcoholic beverage, formerly very popular, especially amongst sailors, who considered it to be a preventative against scurvy. On account of its lightness, strength, reliability and freedom from hidden defects, spruce wood has recently come into general use in the manufacture of aeroplanes.

Many methods of management have been adopted by the large timber and paper manufacturing companies, who use spruce wood more largely than any other wood. The bulletin under review attempts to determine the methods most suited to various conditions. It is estimated that, under average natural and uniform conditions, 50 to 60 years are necessary for the maximum production of wood used for paper pulp; if judicious thinning carried out this period may be shortened by 5 to 10 years. For timber production 100 to 120 years either in virgin or selection forests are required.

The bulletin ends with an appendix containing many volume measurements tables.

537 - **Forest Yield of Public Land in Spain** (1). — BERNARD, F., in *Real Sociedad Española de los Amigos del Arbol, Boletín Oficial de la Sociedad*, Year VII, No. 72, pp. 1-2 May 1917.

According to the data obtained for the year 1913-1914, the forests declared of public utility, which depend on the Ministry of the "Fomento" cover in Spain and the neighbouring islands an area of 11 886 349 acres 29 888 acres less than in the year 1912-1913 due to a rectification of the boundaries. These figures include 609 379 acres (i. e., a little more than 5% belonging to the State, 11 261 746 acres belonging to communes, and 151 acres belonging to other public bodies.

Of the total area, 1 020 304 acres (i. e., 8 % of the acreage of public forests) are being divided up for cutting and 288 891 acres of mountain land are being regenerated and replanted.

The various kinds of trees found in the forests are distributed as follows:— 5 263 223 acres of full-grown pine, oak and beech; 3 088 acres of thickets and 3 534 260 acres of brushwood and pasture land. The income from these forests is estimated at £ 412 247 (*at par*). The principal items are:—

Pasture land	£ 192 994
Timber	87 516
Resin	47 861
Firewood	39 437
Cork	16 883
Esparto	6 499

A profit is also obtained from grazing acorns, fruit, roots, etc. There are great differences in the prices of the various products, less on account of the quality than difficulty of transport. Thus, standing pine costs from 5.98 d. to £1.18.0 per cubic metre (1 cubic metre = 35.31 cubic feet), English oak from 3s.1.66d. to 18s.5.42d., beech from 5.70d. to £1.1 (*at par*).

The requirements of industries which utilise various forest products call for increased exploitation of the forests, while, at the same time, maintenance of livestock and breeding demands improved pasture land.

538 - **Timber of British Guiana.**— See No. 497 of this Review.

539 - **The Galls of *Tamarix articulata* Vahl.**— TRABUT, L. (Professor of the University of Algiers, Director of the Botanical Service of the General Government of Algeria), in *Bulletin de la Station de Recherches Forestières du Nord de l'Afrique*, Vol. I, pp. 171-182 + 6 Figs + 2 Plates. Algiers, 1917.

The "takaout" gall of *Tamarix articulata* Vahl, known as "et" or "tlaia", was well known to the ancients, except that Dioscorides and later writers confound the gall with the fruit of the tree because the galls usually develop at the expense of the flowers, taking the place of the fruit.

(1) See B. 1912, No. 930. (Ed.)

India the galls of *Tamarix* are used in tanning, dyeing and medicine. In the Sahara, *Tamarix articulata* sometimes forms veritable forests; it is the most important tree the Touaregs have, both by reason of the numbers in which it occurs and its utility.

For a long time the gall of *Tamarix articulata* was believed to be caused by a Lepidopteron (*Pamene pharaonana*), but according to the author it is caused by a mite (*Eriophyes ilaiae* Trab. of the same genus as *E. tamaricis* (Natter).

Most of the commercial galls are flower galls, and smaller and more numerous than those of the branches, which may be as large as a nut. The author's observations showed the possibility of forcing the growth of galls on all *Tamarix* which are old enough to flower, thus solving the problem of the production in large quantities of a much valued raw material. In 1883 the Tlemcen tanners paid up to £1.3.2 ½ per 100 lb.; the present price is 14s. 2 ½ d.

A chemical analysis of the flower galls gave the following results:—

Moisture.	12.5 %
Extractive matter.	44.0 %
Tannin.	55.2 %

The galls form in summer and may be harvested in autumn. The *Tamarix* is easily propagated by cuttings and may be used for fixing sand to the coast. Although it is difficult to estimate the yield in galls it must be heavy considering that infected trees always bear a large quantity, so that a harvest of from 16 to 23 cwt. per acre is not unlikely.

The author recommends experimental plantations of *Tamarix articulata* in soils unsuited to other crops, such as sand and saline steppes, which form a large proportion of the unproductive lands. The *Tamarix* might modify advantageously the flora of such lands by favouring the growth of forage suitable for feeding sheep. Cattle eat the twigs of *Tamarix*.

— **Forest Fires in the United States in 1915** (1). — PETERS, J. G. (Chief of State Cooperation Forest Service), in *U. S. Department of Agriculture, Office of the Secretary, Circular* No. 69, pp. 6. Washington, January 11, 1917.

The statistics contained in this circular represent the first attempt at an annual estimate of forest fires in the United States. In general the most comprehensive reports were those obtained from States with organised forest-fire protective systems and from the National Forests. Where no protective organisations existed attempts were made to obtain estimates from the civic divisions of the States and from rural mail-carriers. By this means data were obtained from 37 States, representing about 56% of the forest area of the United States. These States may be divided into three groups: — 1) those giving data covering the total forest area; 2) those giving data covering 60 to 99 % of this area; 3) those giving data covering less than 60 % of the area.

The figures obtained made it possible to draw up the general classification shown in Table I.

(1) See B. 1912, No. 1312. (Ed.)

TABLE I. — *Forest Fires and their Causes in the United States in 1915*

Causes	Number	Percentage
Lightning	2 298	10
Railway	3 548	16
Lumbering	728	3
Brush-burning	3 545	16
Campers	2 347	10
Incendiary	1 751	8
Miscellaneous	2 384	11
Unknown	5 867	26
<i>Total</i>	22 468	100
Total area burned	3 306 650 acres	
Average area burned per fire	147 "	
Total loss caused by fires	\$ 4 009 356	
Average loss per fire	\$ 179	
Average loss per acre	\$ 1.20	

These data concern 304 864 000 acres, belonging to the States from which reports were obtained. An estimate for the total forest area of the United States gives the following figures: —

Area	544 400 000 acres
Number of fires	40 000
Area burned	6 000 000 acres
Loss	\$ 7 000 000

That is to say the area burned represented 1.1 % of the total. Moreover, the loss in young tree growth and the very great damage due to deterioration and floods have not been included.

The returns obtained in the United States show that where there is a protective system most of the fires can be controlled before making headway, and that extensive and destructive fires are few as compared with States having no such protective system. This argues strongly in favour of the formation of adequate systems of protection in all States. The figures in Table II show the cost of such a system.

TABLE II. — *Cost of Protection against Forest Fires in the United States in 1911*

Protected forest area	495 550 000 acres
Total expenditure	\$ 2 738 999.80
Federal Government expenditure	
On National Forests	\$ 2 153 728.17
On State and private lands	\$ 71 860.02
Expenditure of States with protective systems	\$ 513 411.61

LIVE STOCK AND BREEDING.

41 - **The Chemical Composition of Lime-Sulphur Animal Dips.** — CHAPIN, ROBERT M., in *U. S. Department of Agriculture, Bulletin No. 451*, 16 pp.; Bibliography of 10 Publications. Washington, D. C., December 14, 1916.

HYGIENE

Some of the numerous reactions which determine the composition of lime-sulphur solutions are reversible, the points of equilibrium varying according as the solution is hot or cold, dilute or concentrated, or exposed to the influence of other varying conditions. Under such circumstances the only way in which laboratory studies can be of practical value is by so thoroughly establishing the fundamental principles involved and the effect of varying conditions upon the relative importance of such principles as to afford a sound basis for reasoning.

It appears that when lime and sulphur are boiled with water, ignoring mesential and hypothetical intermediate compounds, the following reactions occur : —

- 1) $3 \text{ Ca (OH)}_2 + 12 \text{ S} = 2 \text{ Ca S}_5 + \text{Ca S}_2 \text{ O}_3 + 3 \text{ H}_2 \text{ O}$
- 2) $10 \text{ Ca S}_5 + 3 \text{ Ca (OH)}_2 = 12 \text{ Ca S}_4 + \text{Ca S}_2 \text{ O}_3 + 3 \text{ H}_2 \text{ O}$
- 3) $\text{Ca S}_4 + \text{S} = \text{Ca S}_5$

Only when substantially all free sulphur has been dissolved will equation 2 become operative or equation 3 fail to hold all polysulphide substantially up to the pentasulphide.

All lime-sulphur solutions are subject to hydrolytic decomposition according to the equation : —

4) $\text{Ca S}_x + 2 \text{ H}_2 \text{ O} \rightleftharpoons \text{Ca (OH)}_2 + \text{H}_2 \text{ S} + (x-1) \text{ S}$, the pressure of the reaction from left to right increasing with rise of temperature. Whether or not hydrogen sulphide can escape, the remaining products on the right-hand side react according to equation 1, giving as final result, in case of Ca S_5 ,

- 5) $\text{Ca S}_5 + 3 \text{ H}_2 \text{ O} = \text{Ca S}_2 \text{ O}_3 + 3 \text{ H}_2 \text{ S}$.

Thus all solutions are in equilibrium only when they contain a certain excess of hydrogen sulphide, the amount being dependent upon the temperatures and concentrations of the solutions.

Solutions exposed to air are oxidized, as is usually represented by the equation : —

6) $\text{Ca S}_x + (x-2) \text{ O} = \text{Ca S}_2 \text{ O}_3 + (x-2) \text{ S}$, although it is possible that, as propounded by DRIVERS and SHIMIDZU, the immediate action is an oxidation of the hydrogen sulphide liberated according to equation 4.

Above a certain concentration of the hot solution, which appears to be between 3.33 and 3.95 per cent of monosulphur, the following reaction tends to progress from left to right : —

- 7) $\text{Ca S}_2 \text{ O}_3 \rightleftharpoons \text{Ca SO}_3 + \text{S}$.

A well-boiled solution, not originally made with an excess of lime, can never under any circumstances possess a plus reaction figure — that is, it cannot contain calcium hydroxide in excess of monosulphur. If original-

ly made with an excess of lime or if not boiled long enough, excess lime is at first present in solution. But if such a preparation be allowed to stand quietly and cool off in the cooking vat, the indications are that the undissolved lime soon settles down, while the small amount of dissolved lime rapidly reacts with polysulphur according to equation 2, so that in this case also, unless the cooled solution is again stirred up with the sediment, a plus reaction figure can never be present in the end. Such a solution will naturally contain a notable amount of tetrasulphide.

As regards the period of boiling, it is not improbable that the time should be increased with increasing concentration. Lime is but slightly soluble in the solution at any stage, and it must probably dissolve before it can react with the sulphur. It would seem, therefore, that a longer time must necessarily be required in a given volume for a large quantity of lime to enter successively into solution and into reaction than for a small quantity.

As regards the effect of the degree of concentration, in addition to the decomposition of thiosulphate which has been noted, the indications are that with increasing concentration the utilisation of both lime and sulphur possibly becomes less nearly complete and also that the polysulphides formed possibly contain a somewhat less proportion of pentasulphide. But the apparent effect might have been produced simply by insufficient boiling, and in any case it is of no material significance in comparison with the practical importance of putting out proprietary preparations in highly concentrated form.

Finished solutions, if stored over sediment which contains free lime, will naturally tend to maintain a plus reaction figure and will undergo changes attributable to the slow progress of reactions 1 and 2. If decanted from sediment and preserved from access of air, only two slight changes are noticeable; firstly, the progress of equation 5 until a certain concentration of hydrogen sulphide is reached, when equilibrium is established according to equation 4; secondly, an apparent slight drop in the thiosulphate figure, for which no explanation is offered, since the phenomenon appeared too quantitatively insignificant to warrant special investigation. Both changes, in fact, are so slight as to be entirely negligible for practical purposes under ordinary conditions.

For the actual preparation of lime-sulphur solutions equations 1, 2 and 3 call for the use of 43.7 parts of available calcium oxide to 100 parts of sulphur. That the laboratory experiments did not precisely check this theoretical ratio is attributable solely to the decompositions represented by equations 5 and 6. The decomposition represented by equation 5 is independent of the formula employed and in no way changes the relative proportions of primary ingredients called for; that is, equation 5, following the postulated escape of hydrogen sulphide, produces neither free lime nor free sulphur, and leaves the solution neutral. There remains then only the matter of oxidation to be considered. That is a surface action solely and considering the enormous advantage in the ratio of volume to surface possessed by even moderate-sized cooling vats over laboratory apparatus it approaches a negligible factor. Therefore the theoretical ratio become

the actual ratio which should be followed in practice, provided only the concentration is not sufficient to allow equation 7 to progress from left to right. The formation of sulphite becomes a significant factor when the formula employs somewhat more than 20 parts of sulphur per 100 volumes of finished solution. For a number of reasons the writer believes that it will be generally inadvisable to try for a much higher degree of concentration in "home-made" solutions. Certainly in such solutions no allowance should be made for the formation of sulphite by increasing the ratio of lime to sulphur, as the extent of the decomposition is too dependent on the degree of concentration and length of boiling after the solution is otherwise complete. Attempts to make more concentrated solutions are attended by greater difficulty in manipulating the thick liquid and in avoiding loss by boiling over, and moreover involve more loss of the finished solution in the wet sludge, especially since the volume of sludge is increased by deposition of calcium sulphite.

Nowhere is there evidence of the existence in cold solutions of more sulphur, either free or combined, than corresponds to the formula Ca S_8 . On the other hand, a properly prepared home-made solution will contain at most but a small amount of tetrasulphide. It will also contain a very small amount of hydrogen sulphide, some of which may possibly be in the form of calcium hydrosulphide. While rigidly scientific proof is perhaps lacking at the two apparently definite proportions of four atoms and five atoms of sulphur respectively to one atom of calcium may not, in fact, arise from mixtures of lower and higher polysulphides, it is certainly true that the available evidence points to the existence of only these two.

The methods of analysis have proved to be adequate in scope and accuracy as well as practical. Working in the ordinary way with flasks and pipettes the analyst apparently will not recover from a concentrate more than 99 per cent. of the monosulphur, which indicates a recovery of 99.75 per cent. of the polysulphur, or 99.6 per cent. of the sulphide sulphur, calculating on pentasulphide only. The loss arises chiefly from oxidation during manipulation of the solutions and may be reduced only by manipulating in an atmosphere of some inert gas.

Practical applications. — It is logical to deduce from the data here presented a working formula for the preparation of lime-sulphur solutions. The subject has been dealt with by a number of investigators primarily interested in the preparation of such solutions for horticultural spraying purposes. Some of the formulae so developed seem to have given entire satisfaction for the purpose for which they were intended and the dilutions at which the resulting products should be employed under various conditions have become so well established that any change in formula would be of doubtful practical benefit. It is quite otherwise with solutions intended primarily for the purpose of dipping cattle and sheep. The formulae in use are those prescribed by the Bureau of Animal Industry many years ago when uncertainty regarding possible chemical reactions and possible effects of the resulting compounds upon both animals and parasites very properly led to the use of formulae which should be certain and

safe, even if somewhat uneconomical. The formula suggested here is proposed, therefore, solely for use as an animal dip. It may be termed the "8-18-10" formula; that is, 8 pounds of high grade commercial quicklime, 18 pounds fine sulphur (either flowers or flour) with somewhat more than 10 gallons of water, boiled to a volume of 10 gallons at the finish. The time of actual boiling should be one hour. The theoretical ratio between lime and sulphur will be met by this formula if the lime is 98.3 per cent pure, therefore the formula as given is suitable for the preparation of a solution for dipping sheep where any danger of an excess of lime must be avoided. If commercial hydrated (not air-slaked) lime is used the amount should be increased nearly one-third, say to 10.5 pounds. For dipping cattle the formula may be used on the basis of available calcium oxide if the analysis of the lime is known; if this not known the lime may safely be raised to 8.5 pounds, corresponding to 92.5 per cent available calcium oxide, possibly even to 9 pounds. The manipulation of the materials in the actual process of preparation has been described in a recent publication from the Bureau of Animal Industry (IMES, MARION, Sheep Scab. *U. S. Dept. Agr. Farmers' Bull.* 713, 36 pp. Washington, 1916).

The finished solution, drawn off from the sediment, should theoretically contain 18 per cent (grams per 100 cc.) of sulphide sulphur, but will probably contain somewhat less. It is, therefore, suitable for dipping sheep at a dilution of 1 volume of concentrate to 9 or 10 volumes of water and for cattle at a dilution of 1 volume of concentrate to 7 or 8 volume of water. But in any case, since baths lose strength during dipping, it is very desirable to keep them at all times under control by means of a "field test" (CHAPIN, ROBERT M. A Field Test for Lime-Sulphur Dipping Baths. *U. S. Dept. Agr. Bull.* 163, 7 pp. Washington, 1915).

The particular advantages of the above formula are, firstly that it closely approaches the theoretical ratio, making allowance for impurities; secondly it is as concentrated a product as can be prepared without conversion of thiosulphate to sulphite; and thirdly, the figures are easily remembered and readily converted into the quantities of ingredients necessary to prepare a batch of any desired size.

In deducing a formula for the preparation of highly concentrated proprietary solutions it is evident that the manufacturer must make a few tests with plenty of sulphur in order to establish the conditions which will uniformly yield the product he desires, analysis of which will then show him by how much he may safely reduce the sulphur to allow for the formation of sulphite.

542 - The Toxicity of Carotin. — WELLS, GIDEON H. and HEDENBURG, O. F. (Department Pathology of the University of Chicago), in *The Journal of Biological Chemistry*, Vol. XXV No. 1, pp. 213-216. Baltimore, Md., 1916.

In the course of an investigation of the effects of the bleaching flour by chlorine gas, it became necessary to ascertain the possible toxicity of the pure pigment matter — carotin (1) — both bleached and unbleached.

(1) Only 1 gm. of colour is contained in 1000 kg. of flour. (Ed.)

The purified pigment, chlorinated or not, was dissolved in olive oil, sterilized and injected in guinea pigs intraperitoneally and intradermally. Such large amounts as 0.2 gm. given intraperitoneally or 20 gm. injected intradermally had no effect or caused only a local oedema and inflammation, but no necrosis. Therefore it may be safely concluded that even in relatively very large doses carotin, whether in its natural state or saturated with chlorine, is almost entirely devoid of toxicity.

The studies of PALMER and ECKLES (*Journal of Biological Chemistry*, Vol. XVII, p. 191, 1914) indicate that carotin is almost universally distributed throughout all animal bodies, coming chiefly, if not solely, from the food. The experiments of the authors seem to be sufficient to warrant the assumption that any such quantities as can ever accumulate in the tissues have no harmful effects.

543 - **Studies in Blackleg (Symptomatic Anthrax) Immunization with Special Reference to Blackleg Filtrate.** — EICHORN, A., in *Journal of the American Veterinary Medical Association*, Vol. LII, No. 6, pp. 651-669. Ithaca, N. Y., February, 1918.

Up to the present the most common method of vaccination for immunization against blackleg (symptomatic anthrax) consisted in the injection of attenuated virus prepared in either pellet or powder form.

With this method direct losses from vaccination are known to occur from time to time and insufficient protection following vaccination is also of too common occurrence.

The first investigation on attempts to utilise filtrates of bacterial growths of blackleg for immunization purposes are recorded by FORH. Japanese investigators have continued the work along the lines developed by FORH and, according to Prof. NITTA of the Tokio University, the filtrates obtained appear to afford uniform protection, entirely avoiding losses from vaccination.

The experimental work reported in this paper dealing with the preparation, standardization and immunizing properties of blackleg filtrate, fully substantiated these claims, with the following results: —

- 1) Blackleg filtrate is an effective immunizing agent against blackleg.
- 2) Blackleg filtrate confers an active immunity which protects cattle against the disease for as long a period of time as the germ-free extracts (agressins) prepared from the juice of the tissues from affected cattle.
- 3) Since it does not contain the blackleg germ in any form it cannot produce the disease, therefore losses incidental to vaccination with the powder or pellet form are entirely avoided.
- 4) Blackleg filtrate may be prepared in a concentrated form and, when suitably preserved, will retain its potency for an almost indefinite period of time.
- 5) It is essential to subject the blackleg filtrate to the various tests for sterility, both during the filtration and filling processes in order to guard against any possible contamination.

544 - On the Possibility of the Passage of Trypanosomes into Milk (1). — LANFRANCHI A., in the *Atti della Reale Accademia dei Lincei*, Series V, *Rendiconti*, Vol. XXVII, Pt. I 1st. Half-Year, pp. 62-67. 1 Diagram. Rome, January 6, 1918.

The author wished to ascertain:— 1) if young animals left at the udder would be infected; 2) if it is possible to ascertain the presence of trypanosomes by the direct examination of the milk; 3) if the milk, on inoculation into the peritoneum, could infect rats and mice.

The results have shown that:— 1) *Trypanosoma Brucei*, *T. Evansi*, *T. Lanfranchi*, can pass into the milk of rats; 2) *Trypanosoma Evansi* and *T. Lanfranchi* can pass into the milk of guinea-pigs; 3) *Trypanosoma Lanfranchi* can pass into the milk of mares; 4) the *Lanfranchi virus* can transmit the infection to new-born guinea-pigs through suckling.

The almost universally-recognised fact that trypanosomes in general do not pass from the mother to the foetus, has again been confirmed.

545 - The Basal Catabolism of Cattle and Other Species. — ARMSBY, HENRY PRENTISS, FRIES, J. AUGUST and BRAMAN, WINFRED WAITE, in *Proceedings of the National Academy of Sciences*, Vol. IV, No. 1, pp. 1-4 Bibliography of 12 Publications. Washington, D. C., January 15, 1918.

The basal catabolism of herbivora and especially of ruminants, unlike that of man or carnivora, cannot well be measured in the fasting state on account of the relatively large amount of feed always present in the alimentary canal of the former species. It may, however, be determined indirectly in the manner described by the authors by measuring the total metabolism upon two different amounts of the same ration and from these data computing the level to which the metabolism would be reduced were all feed withdrawn. For example, a steer receiving two different amounts of the same mixed ration gave the following results:—

	Dry matter eaten daily	Daily heat production
	kg.	calories
Period 2	9.146	16,511
Period 1	4.463	10,905
Difference	4.683	5,606
Heat increment per kilogram of dry matter		1.197

Evidently, out of the total metabolism of 10 905 calories in Period 1, $1\ 197 \times 4.463 = 5\ 342$ calories may be regarded as the heat production caused by the 4.463 kg. of dry matter eaten, while the remainder, 5 563 calories, is the basal catabolism.

The writers' investigations upon the metabolism of cattle (2) afford

(1) See R., July 1916, No. 767. (Ed.)

(2) ARMSBY and FRIES, *U. S. Department of Agriculture, Bureau of Animal Industry, Bulletin* 128, 1911. — ARMSBY, *ibid.*, *Bulletin* 142, 1912. — ARMSBY and FRIES, *Journal of Agricultural Research*, Washington, Vol. III, p. 435, 1915; Vol. X, p. 599, 1917; Vol. XI, 1917. See also B. January, 1912, No. 149; December, 1912, No. 1646; June, 1915, No. 625. (Ed.)

data for computing in the manner just illustrated the basal catabolism of unfattened steers in twenty-seven experiments. In view of the very striking effect of standing in increasing the metabolism of cattle the basal catabolism per 24 hours has been computed separately from the observed rate of heat production during the intervals of lying and standing respectively, and also for 12 hours standing and 12 hours lying per day, summed as representing average conditions.

As was to be expected, the basal catabolism increased with the size of the animal but with very considerable fluctuations. The graphs of the results indicate an equally close relation of the basal catabolism with the weight and with the two-thirds power of the weight (computed body surface) and this conclusion is confirmed by a comparison of the coefficients of correlation as follows:—

	With live weight	With $\frac{2}{3}$ power of live weight
Basal catabolism, lying 24 hours	0.8655 \pm 0.0326	0.9032 \pm 0.0239
Basal catabolism, standing 12 hours	0.8733 \pm 0.0308	0.8710 \pm 0.0313
Basal catabolism, standing 24 hours	0.8548 \pm 0.0350	0.8250 \pm 0.0415

Computing the basal catabolism per square metre of body surface as estimated by MOULTON's formulæ viz.,

$$\text{For unfattened animals } S = 0.1186 W^{\frac{5}{8}}$$

$$\text{For fattened animals } S = 0.158 W^{\frac{5}{9}}$$

the following results were obtained:

Basal Catabolism of Cattle per Square Meter of Body Surface.

	Lying 24 hours	Standing 12 hours	Standing 24 hours
Mean, calories	964.0	1173.0	1365.0
Probable error of mean, calories	\pm 24.0	\pm 21.4	\pm 25.7
Probable error of single result, calories	\pm 124.8	\pm 110.9	\pm 133.6
Standard deviation, calories	185.1 \pm 17.0	164.5 \pm 15.1	198.0 \pm 18.2
Coefficient of variability	0.1920	0.1462	0.1451

A positive correlation of the basal catabolism per square metre of body surface with the live weight was also found as follows:—

Coefficients of correlation with live weight.

Basal catabolism per square metre

Lying 24 hours	0.5375 \pm 0.0923
Standing 12 hours	0.3666 \pm 0.1124
Standing 24 hours	0.2405 \pm 0.1223

The results show the marked influence of standing upon the metabolism of cattle, the mean 24 hour basal catabolism lying, standing 12 hours and standing 24 hours being in the proportion of 100 : 121 : 141, the differences largely exceeding the probable errors. Computing, from the result per square metre of surface, the basal catabolism for 12 hours' standing and 12 hours' lying gives as the maintenance requirement for a 1000 pound steer 5918 ± 560 calories.

The results for the basal catabolism of man reported by BENEDICT, EMMES, ROTH and SMITH, and by MEANS are very similar to those obtained by the authors upon cattle with the exception of a much lower variability

Coefficients of Correlation

	With body weight	With body surface
Total basal catabolism:		
98 men	0.7263 ± 0.0320	0.7747 ± 0.0271
75 women	0.7759 ± 0.0310	0.7447 ± 0.0347

Daily Basal Catabolism of Men and Women per Square Metre of Surface

	Men	Women
Mean calories	830.0	768.0
Probable error of mean, calories	± 4.3	± 4.9
Probable error of single results, calories	± 42.3	± 42.8
Standard deviation, calories	62.7 ± 3.0	63.5 ± 3.1
Coefficient of variability	0.0755	0.0827

Correcting for the error shown by D. and E. F. DU BOIS to be incident to the use of the MEEH formula, the means for men and women are as follows —

Corrected Daily Basal Catabolism of Men and Women per Square Metre of Body Surface.

	Men	Women
Means, calories	935.0	886.0
Probable error of mean	± 4.8	± 5.8
Probable error of single result	± 47.5	± 49.4

Including the data obtained by MEISSL, STROHMER & LORENZ, TAYLOR, FINGERLING, KÖHLER & REINHARDT for swine and by ZUNTZ and HAGEMANN for the horse, the following comparison of species may be made

Mean Daily Basal catabolism per Square Meter of Body Surface.

Men (complete muscular rest)	933 \pm 5
Women (complete muscular rest).	886 \pm 6
Cattle (lying).	964 \pm 24
Hogs (lying)	1078 \pm ?
Horse (standing quietly)	948 \pm ?

Considering the nature of the results they show a rather striking degree of uniformity and tend to confirm the conclusions of E. VORR that the basal metabolism of different species of animals is substantially proportional to their body surface. It may be surmised that the exceptional result with the hog is due to the imperfect data available for computing the body surface of this species.

6 - **Adenine and Guanine in Cow's Milk.** — VOEGELIN, CARL and SHERWIN, CARL P. (Division of Pharmacology, Hygienic Laboratory, Washington), in *The Journal of Biological Chemistry*, Vol. XXXIII, No. 1, pp. 145-149, Bibliography of 3 Publications. Baltimore, Md., January, 1918.

In the course of some work on the isolation of the antineuritic substance present in cow's milk, the authors incidentally discovered that this milk contains fair amounts of adenine and guanine. One litre of milk contains at least 5 mgm. of adenine and about 10 mgm. of guanine. These values may be considered as minimum values, as the method of isolation of these aminopurines is by no means quantitative. The question as to whether the purines found in milk are derived from the blood purines or whether they are formed from the breaking down of the nucleic acid in the mammary gland is still left open.

The finding of the writers is of interest in connection with the biochemistry of milk for the following reasons: 1) milk is usually considered to be practically purine-free and has been widely used in metabolism experiments as a purine-free diet; 2) milk was used as a diet in experiments to determine whether or not the animal body can synthesize purines and nucleic acid from purine-free food; 3) under certain conditions the mammary glands may act as an excretory organ for metabolism products, drugs, and poisons.

7 - **The Nature of the Dietary Deficiencies of the Oat Kernel.** — MCCOLLUM, E. V., SOMMONDS, N. and FITZ, W. (Laboratory of Agricultural Chemistry of the University of Wisconsin, Madison), in *The Journal of Biological Chemistry*, Vol. XXIX, No. 2, pp. 311-334 + 9 Diagrams. Baltimore, Md., March, 1917.

FEEDS
AND FEEDING

In this paper the writers present data showing the supplementary relations between the oat kernel and isolated food factors. The experiments were made with rats. The results may be briefly summarized as follows:—

The oat kernel seems to contain proteins of a poorer quality than either the maize or wheat kernel. 9 per cent of oat proteins serve, when all the other dietary factors are properly adjusted, to induce a small amount of growth at the beginning of the experiment, but cessation of growth always follows after about a month and thereafter the animals remain stationary in weight, or decline.

[548-547]

Casein does not appear to supplement the proteins of the oat kernel in a very satisfactory manner. The addition of 10 per cent of casein to 10 per cent of oat proteins, the other dietary factors being properly adjusted, does not induce growth at the maximum rate as do similar combinations of casein with wheat proteins or with maize proteins. Combinations of gelatin and oat proteins in about equal proportions have uniformly proved vastly superior to the similar casein and oat protein combinations.

The unidentified dietary factor, fat-soluble A, is present in very small amount in the oat kernel. It is not possible to supplement the oat kernel with inorganic salts and purified protein so as to induce growth beyond the 3rd month. The inclusion of butter fat or some other substance which supplies the unknown A prevents failure at this point, just as it does in experiments where the ration consists of purified protein salts, carbohydrate, and an extract which furnishes the dietary factor B.

The whole oat kernel, with the hulls removed in the laboratory by coarsely grinding and fanning, will not induce any growth in young rats. A mixture of hulled oats or rolled oats with 5 per cent of butter fat induces very slow increase in body weight for at least 125 days.

The oat kernel, like unpolished rice, wheat, wheat germ, maize kernel, alfalfa leaves, cabbage, and clover leaves, contains a liberal supply of the water-soluble B, the preparations of which induce relief from polyneuritis. The authors found this dietary factor in abundance in all the natural food stuffs in a fresh condition, so far as they employed them in experimental work.

The addition of any single dietary component as protein, inorganic salts, or fat-soluble A does not supplement the oat kernel so as to induce any appreciable growth.

The addition of two dietary factors to the oat kernel serves to induce good growth during the first 60 days when one of the additions is a suitable salt mixture. Without modifying the inorganic content of the ration where this is derived solely from the oat kernel, the authors have not seen rats make any marked increase in body weight. When the oat kernel is fed supplemented by but two dietary factors there is always early failure with loss of weight and death following the brief period of growth.

Failure has, in the writers' experience, supervened earlier than when wheat or maize is fed with the addition of two purified food additions. The oat kernel, like the wheat kernel, appears to cause injury to the animals when their diet is of such a character as to lower their vitality. It is not necessary to assume the presence of something toxic in the oat kernel to account for the injury which results from the presence of a high content of oat in a monotonous food mixture taken over a considerable period. Oats produce faeces of a pasty character which makes their elimination difficult, and in all probability tend to debilitate the animal.

This explanation becomes the more plausible when we consider the marked improvement of rats whose rations were identical except that the proteins of the oats were in one case supplemented by 10 per cent of casein and in the other by 9 per cent of gelatin. There can be no doubt that gelatin

urnishes an amino-acid mixture which makes good the deficiencies of at proteins in a much greater degree than does casein. The improved logical condition of the animals which results from the superior qualitative protein mixture in the former case may render them capable of overcoming the difficulty of elimination of faeces. If this is the real explanation the stunting observed with the oat-casein combinations may be due to absorption of the products of putrefaction from the intestine.

When the oat kernel is supplemented with casein, a suitable salt mixture and butter fat, growth may proceed to the normal adult size at the normal rate in some animals, but, in general, growth is slower than the normal.

The authors have been able to secure reproduction with these rations but a single instance, and the young survived but 1 day.

Feeding Experiments on the Substitution of Protein by Definite Mixtures of Isolated Amino-Acids. — MITCHELL, H. H. (Department of Animal Husbandry, University of Illinois, Urbana), in *The Journal of Biological Chemistry*, Vol. XXVI, No. 1, pp. 231-242, Tables 5 Diagr. Baltimore, Md. August, 1916.

The writer summarizes as follows the chief results of his researches: Experiments are reported in this paper in which mice have been kept for 70 to 98 days by feeding alternately: — 1) rations containing 4 to 6 per cent of various mixtures of isolated amino-acids, 6 to 4 per cent sucrose, 4 per cent starch, 28 per cent protein-free milk (prepared either according to the procedure of OSBORNE and MENDEL or to a modification of this procedure described in the text), 10 per cent lard, and 18 per cent butter fat, 2) a ration containing 10 per cent sucrose, with other constituents in the same proportion as in the first mentioned rations. In many of these experiments periods of 15 to 35 days' duration have been observed in which the mice practically maintained their weight.

The alternate feeding of an amino-acid ration and a non-nitrogenous ration (except for the nitrogen present in the protein-free milk) induced greater total consumption of food than feeding with an amino-acid ration alone, and in all other respects led to more successful results. However, it is probable that in no case was the amino-acid intake sufficiently large to make a fair test of its adequacy.

Amino-acid rations containing no added tyrosine, or no added tyrosine and phenylalanine, did not give appreciably different results from rations containing these amino-acids. However, if tryptophane was absent from an amino-acid ration, the period of survival of mice fed this ration alternately with the non-nitrogenous ration was noticeably shorter than the periods of survival of mice kept on rations containing added tryptophane.

Mice could be kept for much longer periods of time on rations containing mixtures of amino-acids, including tryptophane, fed alternately with the non-nitrogenous basal ration, than when fed the basal ration alone. Furthermore, this difference in survival cannot be accounted for by a difference in energy intake. This fact has been interpreted as meaning that at least some of the amino-acids have specific functions in metabolism aside from that of serving simply as material for the synthesis of body protein. Other

evidence from the literature is cited in support of this view, which is substantially the same as that recently and tentatively put forward by OSBORN and MENDEL (*Journal of Biological Chemistry*, Vol. XX, p. 377, 1915).

549 — **Fat Assimilation.** — BLOOR, W. R. (Laboratories of Biological Chemistry of the Harvard Medical School, Boston), in *The Journal of Biological Chemistry*, Vol. XXIV, No. 1, pp. 447-460. Baltimore, Md., 1916.

The author has made determinations of total fat, lecithin (phosphatides) and cholesterol in whole blood and plasma (and by calculation in the corpuscles) during a series of fat absorption experiments, carried on with dogs with results which are believed to justify the conclusions: 1) that the blood corpuscles take up the fat from the plasma and transform it into lecithin 2) that most if not all of the absorbed fat is so transformed; and therefore 3) lecithin is an intermediate step in the metabolism of the fats.

550 — **The "Optimum Age" for Fattening Off Irish Bullocks.** — WILSON, J., in the *Journal of the Department of Agriculture and Technical Instruction for Ireland*, Vol. XXVII No. 1, pp. 3-6. Dublin, 1918.

The majority of Irish calves are born in spring. For the first couple of weeks they are fed upon whole milk, and then upon meals and separate milk for the rest of the summer. They are then "stored" till they are from 18 to 42 months old, but, in the majority of cases till they are 30 months old. During the first winter of storing they are fed hay, a couple of stones of root or a couple of pounds of cake, and pasture. During the second winter they depend chiefly on pasture, with some hay or straw, and, in some cases, few roots. Only pasture is given the third winter though, in very severe weather, a little hay or straw is added. Under these conditions growth is slow and in autumn the bullocks usually require a month's preparatory feeding before being put upon a fattening ration. Their approximate average weight and their selling value (1) per head at different ages are: birth 70 lb. £2.5s.; at 6 months, 3 cwt., £4 15s.; at 12 months, 4 cwt. £6.10s.; at 24 months, 7 $\frac{1}{4}$ cwt., £11.10s.; at 36 months, 10 cwt. £15.10s.; at 42 months, 11 $\frac{1}{4}$ cwt., £17.10s. Therefore the selling value per pound live-weight of the dropped calf falls from 7.7d. to 3.4d. a pound in about 6 months; after this the variation is slight. If the weight of a new born calf is reckoned at 70 lb. and the drop in value at 4 $\frac{1}{2}$ d. a pound, the total loss is 26s. 3d.; a loss which must be wiped out before any profit can be realised. During the rearing period the calf gains about 1 $\frac{1}{2}$ lb. a day, which, with a selling value of 3.4d. a pound, is roughly equivalent to a daily increase of 5d. in money value. If it can be reared at 3d. a day the loss of 26s. 3d. will be discounted in about 5 months. The rearing cannot, therefore, sell a calf profitably till it is 6 months old unless he gains more than 3.4d. a pound for it.

A medium sized fattening bullock puts on about 2 lb. a day, at a cost of about 11d. (i. e., 5 $\frac{1}{2}$ d. a pound), and is sold at 4d. a pound. The loss of 11d. a pound is, however, only apparent, being compensated for by the rise

(1) All prices in this paper are average pre-war prices.

Months of raising	Costs	Finished live Weight	Cost of Production per pound
		cwt.	d.
months 12 to 18 months (assumed)	Cost of Store Bullock at 12 months Young Pasture and Clover afterwards Cake, 2 lb. a day for one month and 1 lb. for three = 330 lb. Attendance for six months Risk at 2 1/4 % Interest on Capital at 5 %	26.10.0 2.0.0 1.4.0 0.10.0 0.4.0 0.4.0	6 1/2 3.5
months 18 to 24 months (assumed)	Cost of Store at 18 months Hay, 7 lb. a day for four months = 60 stone Straw, 3 1/4 lb. a day = 30 stone Roots, 56 lb. a day = 3 tons Cake and Grain, averaging 4 1/2 lb. = 4 cwt Attendance for four months Risk at 1 1/2 % Interest on Capital	10.12.0 9.10.0 0.16.10 0.5.0 1.10.0 1.13.0 0.7.6 0.3.0 0.4.0	8 1/4 3.58
	Less Manure	14.10.1 0.12.0	
months 24 to 30 months (assumed)	Cost of Store at 24 months Hay, 7 lb. a day for 50 days Straw, 3 1/4 lb. a day Roots, 70 lb. = 56 cwt. Cake and Grain, 4 1/2 lb. = 3 3/4 cwt Attendance Risk at 1 1/4 % Interest on Capital	13.18.1 11.5.0 0.12.6 0.5.0 1.8.0 1.1.2 0.6.6 0.2.0 0.5.6	8 3/4 3.55
	Less Manure	15.3.10 0.9.0	
months 30 to 36 months (assumed)	Cost of Store at 30 months Pasture Cake and Corn, 4 lb. a day for three months = 3 1/4 cwt. Attendance for six months Risk at 1 % Interest on Capital	14.14.10 11.10.0 2.5.0 1.1.2 0.7.6 0.2.6 0.6.6	9 1/2 3.53
months 36 to 42 months (assumed)	Cost of store at 36 months Hay, 7 lb. a day for four months = 60 stone Straw, 7 lb. a day = 60 stone Cake and Grain, averaging 4 lb. a day for 3 months = 3 1/4 cwt. Roots, 84 lb. a day = 90 cwt. Risk Interest on Capital	15.12.8 14.5.0 0.16.10 0.11.6 1.1.2 2.5.0 0.3.3 0.8.6	11 3.67
	Less Manure	19.11.3 0.14.0	
months 42 to 48 months (assumed)	Cost of store at 42 months Pasture Cake and Corn, 4 lb. a day for three months = 3 1/4 cwt. Attendance for six months Risk Interest on Capital	18.17.3 15.10.0 2.10.0 1.1.2 0.7.6 0.3.6 0.8.6	11 3/4 3.82
months 48 to 54 months (assumed)	Cost of store at 48 months Hay, 7 lb. a day Straw, 7 lb. a day Cake and Corn, 4 lb. a day for three months = 3 1/4 cwt. Roots, 112 lb. a day = 6 tons Risk Attendance Interest on Capital	20.0.8 17.10.0 0.16.10 0.11.6 1.1.2 3.0.0 0.3.0 0.7.6 0.10.6	12 1/2 4
	Less Manure	24.1.3 0.15.0	
		23.6.3	

value of every pound of the original lean animal from 3.3d. to 4d., but the size animal realises no profit.

From the time the rearer can afford to sell it till the time the fatterer buys it, the Irish bullock is stored, the period of storing lasting from 1 to 2 years. Since the main function of a store bullock is to convert the more or less unmarketable products of the farm into something which can go to market on its own feet, the owner will naturally prefer an animal suited to the fodder produced on the farm and not too advanced in growth, its age being of secondary importance. There is, however, an age at which the bullock can be put up to be fattened to the best advantage; this age is when the difference between the total gain produced by improving the fattened weight and the outlay upon fattening foodstuffs is at its maximum. This can be determined by estimating the cost of producing a pound of beef with bullocks of different ages. The appended table shows the estimated pre-war costs of producing beef at different ages (page 591).

As grass in Ireland is cheaper than winter foods, the grass fattened bullock costs less to produce. It is seen, however, that, in both cases, the producer's profits begin to decline if the bullock is not fattened off while it is about 2 years old or under. A bullock stored till it is 3½ years old makes a profit, and if such an animal is sold to be fattened, it is clear that if the fatterer makes a profit on it the seller makes a corresponding loss.

551 — **Breeding Hens for Egg Production** (1). — MURPHY, L., in the *Journal of the Department of Agriculture and Technical Instruction for Ireland*, Vol. XVIII, No. 1, pp. 37-40, Dublin, 1918.

The paper under review gives the results of the 5th Irish Laying Competition held, as in previous years, at the Munster Institute, Cork, and the conclusions deduced from them.

The competing breeds included 17 pens of White Wyandottes, 6 of Rhode Island Reds, 5 of White Leghorns, and one each of Black Minorcas, Red Sussex, and Buff Orpingtons. There were, in addition, 4 non-competing pens. Each pen contained 6 pullets.

The dearth of eggs in Ireland in October and November is due to late hatching, heavy breeds hatched in May being useless for winter egg production. The tests showed that with very good laying strains, as, for example, certain families of white Leghorns, late hatching is fairly successful if the feeding and general management during the growing stage are good. The eggs of early hatched pullets are, however, of better size than those of late hatched ones, an important factor when dealing with breeds having a tendency to lay small eggs. Until recently little attention was given to the size of the eggs, though failure to give good sized produce is so serious a fault that it discounts any other merit a strain may have. Good size and large production can be successfully combined but good stock must be used, all hens laying second-grade eggs being rigorously excluded. From the results of these tests it seems that when a pullet has laid a large percentage of small eggs in her first year, but gives good-size eggs about August

(1) For Report of the 3rd competition see *R. May*, 1916, No. 542. (Ed.)

her first season (*i. e.*, at the beginning of her autumn laying cycle), her female progeny are liable to do the same. It is, therefore, wiser not to use such a hen for breeding, even though her pullet record be far above the average and her eggs in the second year 2 oz. or over. To obtain the best results accurate breeding records and careful selection are essential. So-called "line breeding" cannot be continued successfully over a number of years unless the parentage of every bird in the breeding pens is known.

Too much care cannot be taken in the choice of a cockerel to mate with, and special consideration should be given not only to the number, but also to the size of the eggs laid by his dam. The high price paid for such a bird will be amply repaid by the results obtained.

The increase in broodiness in some strains has not yet been definitely explained. In some cases when a non-broody pullet is mated with a cockerel from a non-broody hen, all the progeny will be broody. The most satisfactory explanation is that given by Mr. OSCAR SMART, who suggests that broodiness is due to the presence of two factors, A and B. A pullet inheriting the factors AA or BB will not go broody, but if a bird inheriting AA is crossed with one inheriting BB all the progeny will be broody at some time or other. All that can be advised at present is that a cockerel which has introduced broodiness should not be used again with the same hens.

The food given during the period of the tests included, in decreasing order of the amounts given:—oats, bran and pollard, potatoes, maize meal, wheat, fish meal, dried grains, gluten meal, dried yeast, small quantities of soy mash and concentrates, and greenstuff. Reducing the potatoes to their grain or meal equivalent, 4 lb. of potatoes equal 1 lb. of grain or meal, giving a total of 180 $\frac{1}{4}$ cwt. for the 210 birds, thus 4.31 lbs. of meal were required to produce 1 lb. of eggs. As a large percentage of this meal was unsuitable for human consumption it showed the hen to be very profitable for the conversion of such food into a rich and easily digested human food. The use of potatoes was perfectly satisfactory when balanced by a highly concentrated food, such as fish meal. When, as at present, prices are high, it is far better policy to feed a few birds liberally than to keep a large number on little more than a maintenance ration, for, as such birds are very poor table and useless for egg production, the result is sure to be a loss.

The winning pen (White Wyandottes) laid 1 339 eggs, or an average of 3.2 per hen; the maximum number laid by one hen was 251. The following table gives the general results of the competition compared with those obtained in previous years.

Year	No. of pullets	No. of eggs laid	
		Total	Average per hen
1	318	38 199	120.4
2	282	30 216	139.0
3	260	30 764	150.6
6	294	40 830	169.5
7	210	36 660	174.0

552 — **The Behaviour of Chickens Fed Rations Restricted to: — I) Cereal Grains II) Wheat or Maize Kernel.** — I. HART, E. B. HALPIN, J. G. and McCOLLUM, V., in *The Journal of Biological Chemistry*, Vol. XXIX, No. 1, pp. 57-67 + 2 Tables + 1 Plate. Baltimore, February, 1917. — II. HART, E. B., HALPIN, J. G., and STEENBOCK, H., *ibid.* Vol. XXXI, No. 2, pp. 415-420 + 1 Plate, August 1917.

Wheat is generally considered to have a higher food value than other cereals. The numerous experiments carried out on mammals by the authors since 1911 tend to prove the opposite and show almost beyond doubt that wheat contains a slightly toxic material. Moreover, wheat proteins are of inferior quality, and may partly account for the malnutrition observed by the authors when wheat was fed in excessive quantities. The fact that maize kernel proteins are equally inferior for growth but are nevertheless unsuitable for normal nutrition points to the great probability that the lower food value of the wheat kernel is due to one or more toxic substances. The authors, therefore, undertook experiments with chickens to determine: — a) their resistance to an exclusive or restricted diet b) their food requirements.

I. — Feeding experiments carried out with strong Rhode Island Red hens weighing from 3 to 4 lb., fed exclusively on cereals and their derivatives during 7 to 12 months, showed that chickens started at half the normal weight can grow slowly, maintain themselves, and produce fertile eggs on rations limited to: — 1) maize meal + gluten feed + calcium carbonate, or 2) wheat meal + wheat gluten + calcium carbonate.

These results are in marked contrast to those obtained by the author with swine and rats, in which these rations led to loss of weight, cessation of oestrus, and, with wheat, to a condition resembling polyneuritis.

The mineral requirement, and probably also that of other normal nutritive factors, is not the same for chickens as for mammals. Moreover the fowl's capacity to tolerate without fatal results or a modification of diet the toxic substance contained in wheat, shows its metabolism to differ from that of swine or rats.

When half-grown chickens were used in the experiments no important improvement was obtained in the rate of growth or egg-laying capacity by supplementing the grain with salts, casein, butter fat, or a mixture of the three, as compared with the results obtained with grain + grain protein concentrate + calcium carbonate. The protein content in all cases was about 12 %. The eggs produced on all these rations though fertile were few.

This result, which disagrees with the best practical results in which animal protein concentrates have proved of great value as supplements to a ration of cereal grains for egg production, suggests that either the high plane of protein intake (20-25 %) obtained in practice by the use of animal protein concentrates (meat scraps, milk, etc.) would account for the difference, or else these concentrates contain certain factors necessary to large egg production which are not found in the cereal grains or casein.

II. — The previous experiments were extended to younger chickens weighing from 2 to 3 lb., with the following results: —

Chickens started below half their normal weight can grow slowly and maintain themselves on rations restricted to maize meal, gluten feed, and calcium carbonate. A ration restricted to wheat grain, wheat gluten and calcium carbonate causes death in 3 months. These results agree with those obtained for mammals, especially with regard to the action of wheat gluten.

When compared with the results given above, these show a difference in the behaviour of more mature and younger chickens. The former tolerate wheat, but the latter, like adult or young mammals, succumb to a diet containing excessive wheat. There is also a difference in the mineral requirements of growing chickens and growing mammals.

Modifying the wheat grain by the addition of a complex salt mixture, by this mixture and another change, such as substituting casein for part of the wheat protein, does not improve the dietary properties of wheat for young chickens. Only when butter is added and the salt mixture and casein substituted for part of the wheat protein are tolerance and good growth obtained.

These results do not imply that wheat or its derivatives cannot be fed to growing chickens or mammals, but only show their dietary limitations compared with another species. They also prove that wheat cannot be successfully used as an exclusive diet for young chickens without the introduction of other dietary factors, and show what these factors are.

1. **Studies on the Physiology of Reproduction in the Domestic Fowl.**—PEARL, RAYMOND (Maine Agricultural Experiment Station, Orono), in *The Journal of Biological Chemistry*, Vol. XXIV, No. 2, pp. 123-135. Baltimore, Md., 1916.

In the preceding paper in this series (1) the author has shown that the injection of the substance or extract of the anterior lobe of the pituitary body into the peritoneal cavity of the domestic fowl failed entirely to stimulate the completely resting ovary. These negative results seemed to make attempts at administration *per os* worth while. The results may be summarized as follows:—

Feeding the desiccated substance of the anterior lobe of the pituitary body of cattle to hens in laying condition but at a time of year when the rate of fecundity is declining, does not stimulate the ovary to an increased rate of production.

Feeding the same substance to growing pullets does not bring about any earlier activation of the ovary than occurs in normal control pullets fed this substance.

The anterior lobe of the pituitary body from cattle when fed to growing chicks is accompanied by a distinct retardation in growth in body weight. This confirms for the chick the results which have been obtained with this substance by other investigators (CUSHING, SANDRI, ALDRICH) in mammals.

The feeding of the desiccated substance of corpus luteum brings about a retardation of growth about twice as great in amount as that following pituitary feeding.

(1) See B. August 1915, No. 838. (Ed.)

Neither pituitary substance (anterior lobe) nor corpus luteum substance when fed to laying pullets causes any retardation in the attainment of sexual maturity as indicated by the laying of eggs. The birds so fed began to lay eggs at the same age, but at a smaller body weight than the normal controls.

FARM ENGINEERING.

554 — **State Motorculture in England and Scotland.** — I. *Mark Lane Express Agriculture Journal*, Vol. CXIX, No. 4505, p. 88, London, January 28, 1918. — II. *The Scottish Journal of Agriculture*, Vol. I, No 1, pp. 61-62, Edinburgh, January, 1918.

I. The President of the Board of Agriculture has stated that the area ploughed by Government tractors from the middle of August to January 12, 1918, was 231 000 acres. On the latter date there were 1 813 tractors working.

II. — The Food Production Department of the Board of Agriculture and Fisheries acquired a large number of tractors, one seventh of which were allotted to the Scottish Board. This quantity, however, was not required and only 115 new tractors were added to the previous year's total. These were of the following types: — Titan, Overtime, British Universal, Mollie Wallis, Cub Junior, and Burford-Cleveland.

Considerable difficulty was experienced in providing ploughs for the tractors to suit Scottish conditions. The ploughs brought by the Scottish Board were mostly made by Messrs. SELLAR & SON (Scotland) and OLIVE (United States). One SANDERSON & MILL plough and one CASE plough were bought.

Grubbers, cultivators and harrows will also be provided for use with the tractors.

555 — **Agricultural Machinery in Italy.** — ALPH. V., in *L'Industria*, Vol. XXXII, No. pp. 99-100, 4 Figs. Milan, February 28, 1918.

Of late years great progress has been made in Italy in the construction of agricultural machinery.

The writer first describes a turnwrest plough, with an all-metal frame for hill work, and built entirely in Italy. Its sale price is 1 ½ francs per kg. (instead of ½ a franc — the pre-war price). Large numbers of a plough with the mouldboard carried on front wheels, somewhat like the Belgian plough, are being constructed. Two models can now be delivered, one working at 16, the other at 12 in. deep. They were tested with a drawbar pull of 60 kg. per sq. millimetre.

The writer also mentions the construction of a seed drill of the American type and of a chop-cutter, both machines much in demand in Italy. Two types of chop-cutter are made in Italy: — one with a 12 in. delivery, with round gear wheels, giving 5 different lengths of cut, and with a chain that delivers the forage automatically to the knives; it weighs 175 kg; the other type is simpler, but without an automatic feed. The knives are also of Italian make.

6 - **Energy Required in Cultivation.** — RINGELMANN, MAX, in the *Journal d'Agriculture pratique*, Year LXXXII, Vol. XXXI, No. 3, pp. 66-69, 5 Charts + Tables. Paris, February 21, 1918.

While studying, in 1898, cultivation work in the very fertile soils belonging to the upland silt resting on the tertiary clay of the Coupvray farm, France, the author found that the preparation of the soil for beet after cereals required nearly 8 times more energy than is required in the same soils for winter wheat after beet.

The author calculates that the cultivation of 1 hectare requires, according to the period in the rotation, from 7 to 55 million kilogrammetres, which have to be furnished by the farm teams during a time which is always limited (1).

Elsewhere, on tertiary soils where the method of cultivation is different, the author found just over 8 million kilogrammetres for the cultivation of 1 hectare to carry winter wheat after beet, and nearly 39 $\frac{1}{2}$ million kilogrammeters for beets after cereals; the divergences from the figures obtained at Coupvray are mainly due to the machinery employed, as well as to the depth of the ploughing and scarifying.

Ploughing represents the greatest part of this total expenditure of energy the division of which among the different operations is shown in Table I.

TABLE I. — *Repartition of the Total Expenditure of Energy amongst the Various Operations.*

	Breaking up stubble	Ploughing at 5 to 6 in.	Ploughing	Ploughing at 19 in.	Harrowing	Scarifying	Rolling	Total
	kg.	kg.		kg.	kg.	kg.	kg.	kg.
Preparation of a soil for winter wheat after beet	—	680	—	—	130	—	—	810
			at 6 in.					
for beet after cereals	530	—	830	1 500	160	400	100	3 940
			from 7 to 8 in.					
for spring oats . . .	—	—	1 100	—	200	250	80	1 630
ending off 3-year clover for a winter cereal . .	—	—	1 200	—	230	—	80	1 610
spring off clover for a winter cereal	—	—	1 400	—	240	—	80	1 720

These figures show the average traction in kg. per metre of width worked; to obtain the energy necessary per hectare in kilogrammetres, the average tractive effort must be multiplied by 10 000

(1) These figures would be greater for stronger soils. For the whole work, the energy would be added that is required for carting and spreading manure and fertilisers, sowing, cultivation, harvesting and carting.

For a winter cereal after potatoes, the figures are very close to those for winter wheat after beet.

Table I shows that ploughing represents, according to the case, 83, 76, 67, 80, and 81 % of the total energy required for the various preparatory operations for these soils. In this way is found the cost of ploughing in comparison with that of other operations. Starting from the fact, ascertained on the farm under consideration, that in November a team of 3800 horses ploughed 34 acres at 7 to 8 in. deep in a day of 9 hours' actual work, the author deduces the approximate area cultivated per day for the different operations and the number of actual hours of work required for cultivating 1 hectare, as shown in Table II.

TABLE II. — *Area Worked per Day and Time Required per Acre.*

	Area worked per day acres	Time required per hectare hours and tenths
<i>Preparation of a soil for winter wheat after beets:</i>		
Ploughing at 5 to 6 in.	155	16.4
Harrowing	288	3.1
Total		19.5
<i>Preparation of a soil for beet after wheat:</i>		
Breaking up stubble	70	12.9
Ploughing at 6 in.	45	20.0
Ploughing at 10 in.	25	36.0
Harrowing	187	4.8
Rolling	468	2.0
Scarifying	163	5.5
Harrowing	288	3.1
Scarifying	163	5.5
Harrowing	288	3.1
Rolling	468	2.0
Total		94.9
<i>Preparation of a soil for spring oats:</i>		
Winter ploughing at 7 to 8 in.	34	26.5
Scarifying	150	6.0
Harrowing	187	4.8
Rolling in certain cases	468	2.0
Total		39.3
<i>Clearing off 3-year clover for winter cereal:</i>		
Ploughing at 7 to 8 in.	29	31.0
Rolling	468	2
Harrowing	163	5.5
Total		38.5
<i>Clearing off lucerne for winter cereal:</i>		
Ploughing at 7 to 8 in.	27	33.5
Rolling	468	2.0
Harrowing	156	5.8
Total		41.1

The data of Table II are in agreement with current practice.

7. — **The Agricultural Tractor: Some Factors Governing the Design of a Small Tractor (1).** — CHORLTON, A. E. J., in *Engineering*, Vol. CV, No. 2714, pp. 7-16, Fig. 12, Tables 2. London, January 1, 1918.

The problem of providing mechanical power in the most suitable and efficient form for the purposes of agriculture, is one of no inconsiderable difficulty, the guiding factors being such variables as the size of the farm, the uses of land, the nature of crop, road transportation and the financial ones of first cost, annual charges, etc. Owing to lack of precise information the author has had to provide much of the essential data by actual experiments, the results of which are of great value for all those interested in the agricultural tractor.

After having discussed and compared the advantages and disadvantages of a special power implement for each purpose with those of a multi-purpose machine, the author concludes that the financial consideration of the problem brings out the advantages of a multi-purpose machine, but without necessarily excluding special machines. There will always be farms so large or special conditions of such a nature as to allow of the purchase of special machines. The 3 chief uses which, by their requirements, govern the design of the tractor are: — a) Road work, which governs the minimum axle loading; b) Land work, which governs the maximum axle loading; c) Farmstead, which governs the minimum power required.

ROAD WORK. — The basic factors are adhesion and resistance. The cohesion of the driving wheels on the road must be sufficient to utilise the power developed by the engine in overcoming the tractive resistance of the load and the tractor combined. There exists a considerable amount of data relating to tractive resistance, but for tractive adhesion on common roads, little can be found. For traction on rails recognised constants have been developed from abundant data. The standard figure of adhesion is 0.25, i. e., one-quarter of the load on the driving axles can be used in drawbar pull. After a detailed consideration of adhesion and resistance the author gives the results of his test in 2 diagrams, which will be of great use for tractor construction.

WORK ON THE LAND. — The pressure which worked land will bear without injurious effect on the crops, varies according to the nature of the soil. From the mechanical point of view the limit of pressure is set by the necessity to prevent sinking into the ground, an occurrence which is seldom due to excessive weight. What usually happens is that owing to inadequate gripping power the driving wheels rotate and act as milling cutters, scraping out the soil from underneath. The relative values of weight and spud area are very difficult to allocate so as to be able to make comparisons. For instance, a machine with a 30-cwt. axle loading and short spuds pulls partly by adhesion and partly by grip, the latter being rendered more effective by the weight of the wheel holding the ground down during this action. A lighter tractor with a 15-cwt. axle loading must pull very largely by grip alone and the effectiveness of the grip is modified and reduced by the lighter weight

(1) Paper read before the Institution of Automobile Engineers, London.

behind it, and the greater rolling resistance per ton set up by the spuds. The factors to be determined are, therefore, the proper relation of pressure on the land, the pressure against it, and the action of the rim projection, strake, spud or grouser. In most cases 3 conditions must be met: — a) driving axle loading; b) pressure against grips or spuds; c) effect of rolling resistance. On examining these conditions the author finds that, for light lands, the spud must be increased 4 times, as compared with heavier land. Many useful experiments could be carried out to determine the most efficient form of grip for varying conditions of soil and weight of tractor. On very soft land the wheeled tractor, either by reason of weight or spud pressure, is not suitable, and one of the caterpillar type becomes essential.

WORK ON THE FARMSTEAD. — The highest power required is for threshing, which according to the author's diagram, does not exceed 20 HP, though it is usual to allow 25 HP for large machines.

The appended table summarises the results of the author's experiment and shows the basic requirements for a multi-purpose tractor.

	Power required HP.	Driving axle load t, b
Road work	18 — 20	4 400
Land work	23 — 25	4 400
Farmstead	20 — 25	Stationary

In considering the engine, the conditions should be taken into account under which it has to run on a farm, the inexpert attention likely to be given to it being an important factor. Generally, while this requires robust construction, it also calls for a low power rating or a considerable reserve of power, and probably the factors of low speed, large cylinder capacity for power required, strength and simplicity of parts are the main ones. The engine *must* operate on paraffin, and it should be able to develop its power without water injection. Such an engine running on paraffin would give an economy of 30 %. It should, however, be quite possible to secure better economies with the ordinary engine than are at present customary. It may be taken that the consumption per acre in practice is about 3 gallons. A 20-HP tractor has probably about 12 $\frac{1}{2}$ brake-HP. Taking 2 hours per acre, this gives 12 pints per hour, or 0.96 pint per brake horse-power. This result is not at all a bad one, and is probably much better than when the tractor is run by an ordinary farm hand in daily work. The consumption might well be reduced to 0.85 pint per brake horse-power, or with a high-compression engine to 0.6 pint or even less.

The author suggests that the horizontal type of engine is to be preferred. The high speed engine reduces the weight of the tractor, but in view of the necessity of giving a reasonably long life under conditions of farm usage, it is debatable if this is a wise policy. The system of cooling chosen — radiator or tank system — depends mostly on local conditions.

The writer deals with the following points: — Frame; Gearing; Steering (there is a general tendency to adopt the double-pivot system for

ctor work) ; Wheels (which tend to be reduced in diameter, probably with view to reduce weight) ; Land Grips. The caterpillar arrangement, whilst entirely suitable for special conditions on the land, cannot be considered as desirable for road work.

2. — **Improvements of Agricultural Implements in India.** — HENDERSON, G. S., in the *Agricultural Research Institute Pusa, Bulletin* No. 73, pp. 6 + 8 Plates, Calcutta, 1917.

The author describes several implements introduced by him into India, and which are mostly modifications of implements in common use in Egyptian Agriculture likely to be useful in irrigated districts. The following are worthy of note : —

The Egyptian plough, provided with hardened steel shares and ridging implement.

The scraper, for levelling irrigated land.

The threshing machine ; consisting of 3 axles each bearing 6 or 7 iron discs. The axles turn on iron bearings and the whole rests in an angle iron frame. The machine is pulled by a pair of bullocks and will thresh as much as 5 or 6 pairs of bullocks would tread out. The discs are kept sharp by a file. In working the grain is put in a heap on the threshing floor and a layer spread out on the circumference of the heap. The machine is rolled round this and the straw kept perfectly turned. Fresh material is gradually placed on the beaten layer until it is all beaten.

The author also describes 2 Archimedian screw water-lifts, as well as a Dutch water wheel. This latter is now used in Egypt, and Dr. PARR, of the United Provinces, gave the machine a trial and reported favourably on it.

3. — **Implements Used for Cultivating Rice in India.** — GILBERT, T., and SALIMATH, S. S., in *Department of Agriculture, Bombay, Bulletin* No. 82 of 1916 (Cultivation of Drilled Rice in South Bombay Presidency), pp. 6 + Fig. 23. Poona, 1917.

This bulletin, which deals with the cultivation of drilled paddy, contains figures drawn to scale of the various native implements used in the South Bombay Presidency.

There is an extraordinary variety of implements in use for the cultivation of drilled rice. They are designed : — 1) to break the soil after the first rain ; 2) to level the surface and at the same time to break clods ; 3) to level the soil to a fine seed bed ; 4) to sow the seed ; 5) to intercultivate and remove weeds ; 6) to puddle the soil and at the same time to remove clods.

The different implements, together with their native name are briefly described below : —

- 1) bullock plough ;
- 2) the " kodda " and " kodati " for clod crushing ;
- 3) the " halka " brings clods to the surface ;

4) The threshers now used in Persia consist of a square wooden frame, carrying 2 wood axles and 4 iron discs. The machine described by the author constitutes a notable improvement, and would be very suitable to Persian conditions which do not allow of the use of modern agricultural machinery. (Ed.)

- 4) the "kunti" for harrowing;
 - 5) the "doni" for levelling the soil;
 - 6) the "rool", a roller fitted with spikes;
 - 7) a 6 tyned seed drill, sowing 36 to 72 lb. of seed;
 - 8) the "henta" as a brush-barrow, after sowing;
 - 9) the "hutgunti", a 6-tyned hoe drawn by a pair of bullocks in some parts the 2-tyned "yedikunti" is used;
 - 10, the "repani" similar to the "hutgunti", but with the cutting edges of its blades rounded;
 - 11) after the fields are flooded, the "ghute" is used for cultivating levelling the surface, and uprooting shallow rooted weeds;
 - 12) the "baskooti" is a wooden hand rake for collecting the weed.
- The crop is cut with a sickle and laid in rows in the field; it is threshed and handled by means of various native tools and implements.

560 - The "Acrometer". — *The Implement and Machinery Review*, Vol. XLIII, No. 3, pp. 1187-1188, Figs. 2. London, March, 1, 1918.

An instrument invented and placed on the market by Mr. W. (GEORGE, Tunnel Hill, Worcester, England, to measure the acreage covered by tractor ploughs. The "Acrometer" measures from one 9-in furrow up to 6 furrows either 9 in. or 10 in. wide, and can be fitted to any plough in 10 minutes; whilst it will also register the work of other implement such as mowers, binders, etc., up to 6 ft. wide or over.

The instrument will be very useful for measuring areas in tractor ploughing tests. It costs £5.

561 - Double Disc-Harrows for Mechanical Cultivation. — *MANRIN, G.*, in the *Journal d'Agriculture pratique*, Year LXXXII, Vol. XXXI, No. 3, pp. 50-51, 2 Figs. Paris, February 7, 1918.

Tractors can pass over ploughed land quite safely if they do not exceed a certain weight and if they are followed by a disc-harrow. The double disc-harrow gives excellent results; in the 1917 Noisy le-Grand (France) tests, with a double machine with 32 discs, working a width of 103 ft. and a depth of about 3 to 4 in., M. RINGELMANN found that traction on already-hardened ploughed-land varied between 1034 and 1188 lb.; at 3 in. depth the work was well done, while at 4 in. the work was excellent.

The author describes: 1) a double disc-harrow, with 16 in. discs, built by T. PILTER of Paris; the machine is built in 2 models; one with 32 disc weight, 1 078 lb.; width, 95 in.; the other with 40 discs; weight, 1 254 lb. and 118 in. wide.

2) a double disc harrow, made by the same maker, provided with toothed discs; the 32-disc model weighs 1 276 lb., and covers 95 in.; the 40-disc model weighs 1 342 lb. and covers 118 in. The discs of these 2 models are 18 in. wide.

The machines have steel frames; there are 4 levers, one per row of discs, so as to control the angle as well as the depth and character of the cultivation. In very hard soils, suitable weights can be placed on the frames to give greater grip.

1. - **Harrows with Rotary Spades.** — MANRIN G., in the *Journal d'Agriculture pratique*, Year I, XXXII, Vol. XXXI, No. 5, pp. 92-93. Figs. 2. Paris, March 7, 1918.

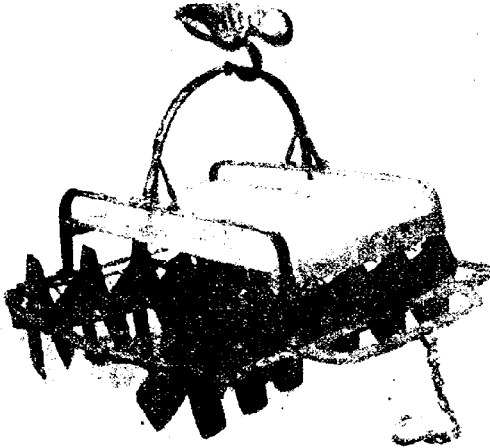
To break down the soil still further, harrows are used, whose toothed spades are replaced by members similar to stamped spades, called "herse bèches roulantes, système WASSIS" in Switzerland, where they are much used.

As shown by the appended figure, the spade consists of a pressed steel plate fixed symmetrically on the axle; the successive spades are so mounted that their extremities follow 2 spirals. As with the discs of double disc-harrows, the spades are fixed on 4 shafts inclined towards the line of traction; the inclination of these shafts cannot be altered during work; the shafts run on bearings fitted with STAUFFER lubricators running thick grease. The spades are scraped by iron rods fixed between consecutive members. A platform is provided on the frame so that weights can be added if the driver's weight does not suffice.

For transport, the seat is removed, and the machine tipped over, when it slides on 2 flat runners.

In another model, the harrow is mounted on a tricycle. By means of a lever the spade-frame can be lifted on the 3 wheels for transport on the road.

These harrows are made by the Société FRITZ MARTI, of Berne, Switzerland. The small model has 28 spades mounted in groups of 7 on each



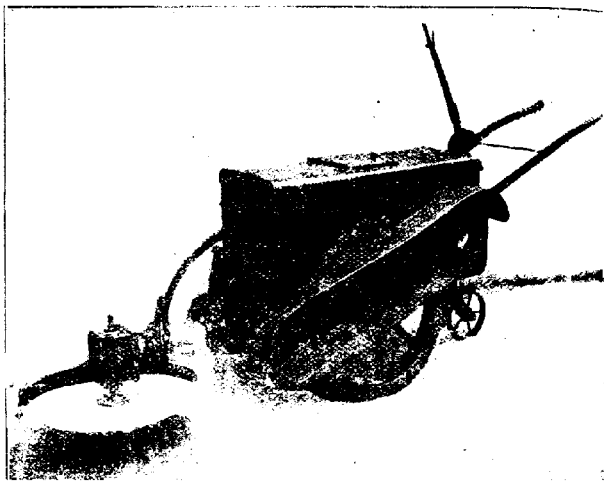
The WASSIS harrow with rotary spades.

shaft; it works a width of 43 in., and weighs about 400 lb. The large model weighs 462 lb., and has 36 spades mounted in groups of 9; it works a width of 55 in.

In medium soils, a team of 2 horses suffices to draw the small model while the large one requires 4. The machine can produce a tilth some 3 or 4 in. deep under good conditions.

563 - **The "Bucheronne", a Machine for Felling and Sawing Coppice-Wood.** — MATHIS DE GRANDSEILLE, in the supplement to the *Bulletin de la Société des Agriculteurs de France* (Comptes Rendus de l'Assemblée Générale de 1917, 48th Meeting), pp. 51-52. Paris, January, 1918.

M. MATHIS DE GRANDSEILLE, President of the 4th Section (Forestry) of the "Société des Agriculteurs de France", reports the results obtained by M. PROCHE's machine — the "Bucheronne" — for felling and sawing timber (1), reproduced in the appended figure.



The "Bucheronne", for felling and sawing coppice-wood.

(1) On the request of M. MATHIS DE GRANDSEILLE, president of the Forestry Section of the "Société des Agriculteurs de France", M. PROCHE, the inventor, has communicated the following additional information: —

The "Bucheronne" weighs about 550 lb. with its 3 HP. electric motor; its speed can be varied and it has a special circular knife-blade whose rounded, bevelled knives are followed by a plane-tooth to clear the cut. The knife blade works in every direction and may be used quite close to the soil. To drive the machine, a 5 HP. electrogenerating set is needed, furnishing a 220 volt current for the motor of the machine. The generator may be as much as 10 ft. away.

[562-563]

The machine was tested in Crains forest, Yonne, France, in the presence of several officers of the Forest Inspection Department, the Central War Material Department of Angoulême, the Air Ministry, Woods and Forests, and Patents Office (Engineering section). According to their report, the soil should first be cleared of all shoots of less than 2 ½ in. in diameter. In woods over 30 years old, this is usually unnecessary; for good and continuous working there is needed: 1 driver for the machine, 1 sawyer for the knife-blade, 1 workman to guide the felled tree the right way, and assistants to trim the felled trees and place them in heaps ready for sawing; total: — 5 men. For sawing, the same number of men is needed at the machine. The yield is very satisfactory, especially when compared with that of previous experiments. With the "Bucheronne" 5 men felled 120 trees of 2.7 in. diameter in 1 hour, and the crew of 5 men felled and sawed in 1 day, 741.63 cu. ft. of wood, while the same crew, working with axes, only felled and trimmed 1059.5 cu. ft. in 4 days. With the machine each workman will produce 141.26 cu. ft. per day, while without he will only produce 35.31 cu. ft. If the coppice is older, the yield will be better. The machine, which is strongly built did very well throughout the trial. The inventor should improve the machine by furnishing greater grip on the soil and by providing a hood so that the knife blade can be inspected during working. It is hoped that the ASTER Co., which has the patent rights over the machine, will improve it.

1 — The Austin Excavator for Drainage Ditching. — See No. 506 of this Review.

2 — The Use of Hydrogen for Driving Engines: Tests in Holland. — Extract from the *bulletin des Usines de Guerre*, in *Le Génie Civil*, Vol. LXXII, No. 13, p. 224. Paris, March 30, 1918.

Experiments carried out at the Hague with a motor car driven by hydrogen have shown that: —

- 1) a car engine will work quite regularly and perfectly on a mixture of pure hydrogen and air.
- 2) the engine does not require adaptation.
- 3) the engine can work smoothly even with a very primitive type of carburettor.
- 4) the experiments that preceded the practical tests did not require a great outlay; a few tubes of hydrogen and the necessary mounting was all that was required.

These tests were carried out as a result of the shortage of petrol for the automobiles in Holland. A 1906 type "Spyker" 10-15 HP motor-car was used, which still ran well on petrol and which could still do over 50 miles an hour.

Below the body was placed a tube of hydrogen, 50 in long and provided with a manometer and a pressure-reducing valve. The hydrogen passed under 1 atmosphere pressure in a metallic tube leading to the carburettor. A tap, placed on the gas tube and connected to a pedal, controlled the supply of hydrogen. The air supply was not very well regulated, being done by hand, before starting.

After regulating the entry valves, in spite of the primitive form of the

carburettor, the engine worked quite smoothly and evenly without misfiring. The number of revolutions was found to be less with hydrogen than with petrol. By igniting at 8 mm. distance from the dead-centre, the maximum number of revolutions was obtained. No traces of naphthalene were found in the exhaust gas, which was found to be pure steam. The engine therefore worked perfectly on hydrogen and air, and that in spite of the casual methods used for adapting the carburettor.

The car started off on the first speed, changing to the second, and after running 15 minutes on the road, returned normally, the engine working perfectly all the time.

The tests and the trial run, which took 30 minutes in all, had required $1\frac{1}{2}$ cu. metres of gas, while the pressure had fallen from 160 to 160 at mospheres.

566 - Review of Patents.

Tillage Machines and Implements.

Canada	180 157. Land levelling machine.
	180 607. Plough.
	180 629. Agricultural implement.
France	485 926. Rotary tilling perforator.
	486 009. Plough for mechanical traction.
Switzerland	77 326. Motor plough.
United Kingdom	110 892 — 112 230. Motorploughs.
	111 550. Motor driven land roller.
	111 917. Harrow.
	112 071. Plough.
	112 674. WYLES Balance motorplough.
	112 815. Balance plough to be hauled by cable.
United States	1 251 498. Tractor plough.
	1 251 632. Drag attachment for ploughs.
	1 251 636. Harrow attachment for ploughs.
	1 251 874. Disc scraper.
	1 251 945. Tilling machine.
	1 252 432. Agricultural implement.
	1 252 491. Plough attachment.
	1 252 574. Caster wheel for agricultural implements.
	1 252 658. Ridger.
	1 253 089. Plough depth regulator.
	1 253 175. Disc harrow.
	1 253 177. Plough share.
	1 253 307. Revolving harrow.
	1 253 609. Harrow.
	1 253 860. Disc garden plough.
	1 253 943. Attachment for sulky ploughs.

Manures and Manure Distributors.

Canada	180 470. Fertilizer distributor.
United Kingdom	111 552. Manure or like distributor.
United States	1 253 560. Process of extracting potash from felspar, etc.

Drills and Seeding Machines.

- ited Kingdom 112 709. Planting tool.
ited States 1 252 668. Plant setting machine.
1 252 923. Check row planter.
1 253 621. Seeder.
1 253 694. Maize planter.
1 254 266. Furrow opener for seeding machine.
1 254 555. Planter.

Various Cultural Operations.

- 180 226. Weed destroyer.
ited States 1 251 786. Tree protecting device.
1 251 821. Cultivator attachment.
1 252 128. Motor-cultivator.
1 252 627. Garden tool.
1 252 674. Cotton chopper tool lifting mechanism.
1 252 749. Two row cultivator.
1 252 914. Vine cutter.
1 252 958 — 1 254 548. Cotton choppers.
1 252 359 — 1 253 480 — 1 253 993. Maize cultivators.
1 253 529. Attachment for Lister cultivators.
1 254 600. Furrow filter and cultivator.

Control of Diseases and Pests of Plants.

- 180 648. Poison for rodents.
ited Kingdom 111 536 — 111 873. Animal trap.
111 876. Sprayer.
ited States 1 252 510. Insecticide.
1 252 756. Tree sprayer.
1 253 672. Dusting and spraying apparatus.

Reapers, Mowers and Harvesting Machines.

- ited Kingdom 112 198. Sickle.
ited States 1 251 492 — 1 252 150. Horse hay rakes.
1 251 939. Harvester reel support.
1 252 016. Cotton picker.
1 252 063 — 1 252 608. Harvesting machines.
1 252 421. Lawn mower.
1 252 631. Kafir-corn header.
1 252 880. Double row corn cutter.
1 253 153. Seed saving attachment for mowers.
1 253 611. Maize husker.
1 253 771. Cotton picker device.
1 254 202. Stooking machine.
1 254 370. Hay and grain sweep.

Machines for Lifting Root Crops.

- 2 205. Machine for lifting plants without damaging the roots.
ited States 1 251 575. Potato-digger.
1 251 589. Beet topper, digger and loader.
1 251 664 — 1 252 230 — 1 253 426. Beet harvesting machines.
1 254 488 — 1 254 004. Beet toppers.

Threshing and Winnowing Machines.

- Canada 180 613. Threshing machine.
 United Kingdom 112 367. Flax threshing machine.
 United States 1 251 520. Seed screening and selecting means for cotton gins.
 1 252 398 — 1 253 167 — 1 254 422 — 1 254 506. Threshing machines.
 1 253 312. Bean saving device for threshing machines.
 1 253 601. Harvesting and threshing machine.

Machines and Implements for the Preparation and Storage of Grain, Fodder, &c.

- Netherlands 2 107. Fruit sorting machine.
 Switzerland 77 328. Press for maize silage.
 United States 1 251 519. Hay drying and the like.
 1 251 573. Grain drier.
 1 251 759. Hay stacker.
 1 252 503 — 1 252 901. Hay loaders.
 1 253 031 — 1 253 170. Shock loaders.
 1 254 175. Feeder for pneumatic stackers.
 1 254 203. Maize shock loading machines.

Steering and Traction of Agricultural Machinery.

- United Kingdom 111 302. Agricultural tractor.
 112 382 — 112 579. Tractor couplings.
 United States 1 251 553 — 1 251 613 — 1 251 416. Traction machines.
 1 252 167. Tractor for ploughs.
 1 252 356 — 1 253 613 — 1 253 319 — 1 253 833. Tractors.
 1 253 073. Axle mount for tractors.
 1 253 578. Flexible tractor tread.

Feeding and Housing of Livestock.

- Canada 180 448. Manger mechanism.
 United Kingdom 111 777. Shoes for horses and mules.
 United States 1 251 672. Hog feeder.
 1 252 256. Hog oiler.

Poultry Farming.

- United Kingdom 112 048. Hatching and rearing appliance.
 112 137. Automatic feeding appliance for poultry.
 112 215. Method for preserving eggs.
 United States 1 254 193. Combined poultry feeder and drinking fountain.
 1 254 273. Egg turning mechanism for incubators.

Industries Depending on Plant Products.

- Brazil 9 959. New process for extracting oil.
 United Kingdom 110 915. Process of treating grain to modify the flavour.
 111 523. Conveyer for bakery plant.
 111 676. Process for extracting oil from the pericarp of palm nuts.
 111 906 — 111 907. Process for purifying India rubber.
 112 164. Artificial butter.
 112 166. Process for purifying alcohols, etc.
 112 232. Process for manufacturing alcohol.
 112 286. Apparatus for depericarping palm fruit and for like purposes.

Industries Depending on Animal Products.

- United Kingdom 112 173. Treatment of meat intended to be preserved by chilling

Dairying.

Switzerland	77 366 — 77 367. Churns.
United Kingdom	111 527. Vessel for storing and heating milk. 112 034. Teat cup for milking machine. 112 060. Cow milker.
United States	1 251 465. Pasteurising apparatus.

Farm Buildings and Equipment.

Canada	180 178. Door for silos. 180 199. Machine for making cement shingles. 180 409. Fence stay.
United Kingdom	112 040. Ground augers.
United States	1 251 794. Shingle. 1 252 477. Automatic litter carrier.

Various.

United Kingdom	112 292. Centrifugal pump.
United States	1 251 552. Flower pot. 1 251 619. Wind mill. 1 252 160. Rotary pump.

AGRICULTURAL INDUSTRIES.

697 — *The Passage of Wine over Fresh Lees.* — CARLIS, P., in *Bulletin de l'Association des Chimistes de Sucrierie et de Distillerie*, Vol. XXXIV, Nos. 10-12, pp. 331-339. Paris, April-May-June, 1917.

When new wine has been allowed to run freely much more wine than dry residue is left in the lees. The wine is retained in this sort of sponge by multiple adhesion caused by the large surface, by capillarity, and, finally, because it is held in small cells (as water in starch jelly).

From 100 kg. of lees which have been drained only about 45 kg. of wine may be obtained by pressing. A certain part will, however, resist pressure; this is the part in the finest capillary tubes, the smallest cells. To remove it the liquid must be mixed with another liquid, which will eject it by capillary force. It is on this principle that is based Roos's diffusion method, which enables 70 % of wine, as pure as that originally drawn off, to be obtained from drained lees, whereas pressing only yields 30 % of this amount.

If these 70 kg. are removed from the 100 kg. of drained lees, 30 % of solids are left in which are found closely mixed: — 1) bi-tartrate potassium (cream of tartar); 2) tannin; 3) colouring substances; 4) pectic products; 5) substances imparting smell; 6) yeasts; 7) abundant ferric salts combined with 8) various mineral salts.

If, when a proportion of the wine represented by 100 kg. of lees has been drawn off, the new wine in the cask is replaced by an equal volume of old wine, and the contents again drawn off, the liquid obtained is equal in volume to the first, but its quality and composition vary according to the length of time it remained on the lees. If it has only passed over the lees without being left on them, the new element will be that part of the wine

INDUSTRIES
DEPENDENT
ON PLANT
PRODUCTS

which came in contact with each individual portion of the mass. It will be represented by the 45 kg. of new wine which pressing would easily have extracted, so that the second drawing off will be a mixture of the 45 kg. of new wine + the old wine; the last 45 kg. of old wine will have driven out the other and taken its place.

If contact with the lees is prolonged the influence of the new wine will be felt more because that contained in the capillary tubes will have had time to be replaced. The wine from the cask will contain all the new wine retained in the lees and old wine which for some time has been in contact with their reserve elements. As this reserve is large and usually greater than that which can be dissolved by a normal wine, all badly composed wine poured on this mass will tend to improve, by absorbing that in which it is lacking. Thus a sour wine which disease has rendered deficient in tartaric acid will take up this element in particular, a flat wine will take up flavour, a poor, exhausted wine will take up a provision of tartar.

If, for example, in a series of three casks, one, for some reason or other has yielded a poor wine, it will be advisable to pass it over the lees of the two others successively, the weaker being used last.

In spite of all the care possible, wines sometimes have a bad flavour detrimental to their use (flavour of mould, addled eggs, bitterness, fustiness, sourness, etc.). Such wines may often easily be improved merely by passing them over fresh lees, because they are aerated without exposure, and moreover, in their immediate contact with the yeast they give up the flavours and smells of the disease.

So as to avoid after-taste all the head must be removed from the cask before the operation, because this is always more or less sour and contains the organism known as mother of vinegar.

When a defective wine is so treated, one of the defective elements remains in the lees, and the pressed wine and small wine finally obtained are of a quality inferior to that obtained by ordinary methods. Wines attacked by "casse" cannot benefit by the treatment described unless they have been previously completely cured of the disease.

568 — **The Alcoholic Fermentation of Banana Must** (1). — PERATTI, R., and RIVIERA, V. in *Le Stazioni sperimentali agricole italiane*, Vol. I., Pt. 9-10, pp. 433-450, 1 Plate, with Figs. Modena, 1917.

The various products of the *Musa sapientum* banana are first enumerated.

Little work has been done on the banana from a microbiological point of view. An important study by Mr. BAILEY (2) shows that the internal part of the pulp is sterile, but that bacteria are present in the internal part of the skin; during the normal ripening process these bacteria may find then favourable conditions of development. Messrs. ROTHENBACH and EBER

(1) See also *B. Nov.*, 1914, No. 1054. (Ed.)

(2) BAILEY, E. M., *Biochemical and Bacteriological Studies on the Banana*, *Jour. Amer. Chem. Soc.*, Vol. 34, No. 12, pp. 1700-1730, 1912; *Jour. Biol. Chem.*, Vol. I No. 2, 1912. (Author).

LEIN (1) show that the formation of the ethers of the banana (isovalerianic-isosamylic ether and ethylic ether) does not depend on bacterial action. As regards the utilisation of the banana for fermentation, there is only the paper of M. D'HERELLE (2), who discusses the possibility of using the residue from the preparation of dried bananas and their flour for making fermented drinks. The authors, therefore, considered that a bacteriological study of the banana and the fermentations to which it may be subjected, would be of interest.

The fermented liquid obtained with a must of skinned bananas distinctly showed the characters of alcoholic liquids, but had lost the delicate flavour of the fruit. As this was attributable to the absence of the banana skin the experiment was recommenced, leaving the pulp in the skin.

The must was prepared as follows: the whole fruit was cut into thin slices and passed through a press; the liquid obtained was filtered through linen and diluted with water in the ratio of 1 : 2.5 parts. The residue was digested for 10 hours at 80°C. in 2 $\frac{1}{2}$ times its weight of water, and the filtered liquid mixed with the first, so that the final liquid was diluted to $\frac{1}{5}$. This must, of a fine dark yellow, was filtered through paper and kept in sterilised flasks.

Part of the must was used for the preparation of a special nutritive gelatine, by the addition of 10 % of commercial gelatine, and for the preparation of a special agar, by the addition of 1.5 % of agar. Another part, removed before sterilisation, was fermented at 28°C. The fermentation started rapidly and was strong; acidification started after 48 hours.

The following bacteria were isolated and grown on the banana gelatine and agar: —

- 1) a *Saccharomyces*, predominant in the liquid, which the authors called *Sacch. Musae*; 2) a bacterial form, abundant in the liquid (*Bacillus* sp. ?); 3) a variety of *Oospora lactis*; 4) a variety of *Mycoderma*.

The authors describe the first three microorganisms and give in details the results of the study of their nutrition, their growth in various culture media, and their action when isolated, combined in groups of two, or all three together. From this last point of view it was noticed that the action of the *Saccharomyces* is inhibited by the presence of the bacterium, and also, though much less, by the presence of the *Oospora*. The following results were obtained with the banana must: —

Microorganism	Specific gravity at 15° C.	Alcohol per 100 in volume
<i>Saccharomyces Musae</i>	0.9978	1.48
<i>Bacillus</i> sp.	1.0000	—
<i>Oospora lactis</i> var	1.0000	—
<i>Sacch.</i> + <i>Bacillus</i>	0.9992	0.53
<i>Sacch.</i> + <i>Oospora</i>	0.9980	1.34
<i>Oospora</i> + <i>Bacillus</i>	1.0000	—
<i>Sacch.</i> + <i>Oospora</i> + <i>Bacillus</i>	0.9990	0.67

(1) ROTHENBERG, F. and EBERLEIN, L., The Occurrence of Esters in Bananas, ref. in *Exp. Stat. Read.*, Vol. XVII; *Deut. Ess. industrie*, No. 6, pp. 81-82, 1905. (Author).

(2) D'HERELLE, F. II., Utilization of the Surplus Banana Crop, *Bull. Ofic. Soc. Agr.*, Vol. 3, No. 3, pp. 241-243, Cuba, 1907. (Author).

In view of the unfavourable influence of the bacillus and *Oospora* the experiments were henceforth only carried out with *Sacch. Musae*. Banana must was prepared with 5.5 lbs. of finely cut fruit and skin digested with twice their weight of water at 55° C. for 2 hours on 3 consecutive days. The liquid was sown with the *Saccharomyces*, after a sample had been taken for an analysis which gave the following results: —

polarisation before inversion	2.40 %
" after	2.30 "
Refracting before	6 "
" after	6.1 "

thus showing the absence of saccharose and the presence of glucose and invert sugar, which, calculated as invert sugar, are present in the proportion of 68.66 ^g/₁₀₀.

Fermentation was set up in 4 litres of must in a large glass bottle. The determination of the alcohol, made when the strong fermentation had ceased (after 10 days), gave a specific gravity at 15° C. of 0.9979 and 1.41 % of alcohol in volume; ²/₃ of the sugar had, thus, already changed to alcohol.

Part of the fermented liquid was rapidly filtered through cottonwool, without pressing the solid portion, and the filtrate poured into a bottle which was hermetically closed.

The bottle was opened after about two years, and the contents found to have kept well. The liquid had the pleasant smell of the fruit, was very clear and straw coloured. The taste, however, did not fulfill the promise of the smell. This was due to the dilution of the must, which made the wine rather flavourless and its alcohol content low, while the amount of sugar present was insufficient to compensate for these faults. It is, however, impossible to avoid such a dilution because of the excessive thickness of the undiluted must and its high content in mucilaginous substances. It is practically impossible to prepare an alcoholic drink by the fermentation of natural banana must; it is necessary to add sugar, and, perhaps, to purify the must when the strong fermentation phase is passed. Under these conditions it is possible to obtain successfully from the banana a fermented liquid of good colour, slightly alcoholic and of attractive qualities, amongst which the agreeable smell of the fruit holds first place. The authors intend to carry out further experiments on the subject.

569 — **The Production of Alcohol from Algae.** — KAYSER, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 14, pp. 450-451. Paris, April 17, 1918.

For some time marine algae have been used as a food for man on account of their richness in carbohydrates. Quite recently they have also been used as a substitute for oats in the feeding of horses (1). In bacteriology agar agar (gelatine) is used as a basis for nutritive media. In this case the gelatine media and the acid solutions must be sterilised separately and mixed after sterilisation so as to prevent the gelatine from changing into sugar.

The author (Lecturer at the National Agricultural Institute) has made

(1) See R. March, 1918, No. 320. (Ed.)

an investigation into the amount of fermenting sugars which might be obtained under pressure and by the action of acids.

At the Pasteur Institute the water content of *Laminaria digitata*, previously washed to extract the mineral salts, or unwashed, was reduced by evaporation to 10 %. The algae were then treated with water containing 3, 4, and even 6 % of sulphuric acid for half an hour or an hour at 122° C. The sugary liquid was neutralised to 1 ⁰/₁₀₀ of acidity, nitrogenous material added in some cases, and sprinkled with brewers' yeast. Fermentation occurred without difficulty, but somewhat better in the flasks containing nitrogenous matter. An average of 6 litres of alcohol per 100 lb. of dry algae was obtained.

It is probable that larger quantities could be obtained commercially, when higher pressure is possible. The author is of opinion that the solid liquid residue could subsequently be used for the extraction of mineral matter and potash, thus serving a double purpose.

570 — **Sorghum or Dari, a New Substitute for Malt Used in Brewing.** — RAUX, J., in *Brasserie et Malterie*, Year VII, No. 24, pp. 372-375. Lyons, March 5, 1918.

For several months brewers have been offered as a new substitute for malt, sorghum or dari, also called "dura" and "Guinea millet". Owing to the high price of rice and maize, used as substitutes in brewing, and their present use, particularly for bread-making, it was suggested that sorghum, which is cheaper, might be used in their stead. It is offered either as a meal or as whole grains; sometimes the grain is not decorticated and the yield of extract is then low (about 10 %).

The moisture content is from 12 to 15 %. If too damp the sorghum quickly goes bad turning sour and takes on an abnormal odour.

The yield in extract — 64 to 70 % — is much below that given by maize, and especially by rice. In maize it depends on the extent of cleaning. Sorghum is delivered at the brewery without any special treatment, but it could be easy to treat it in such a way as to remove part of the fats, which amount to 3 to 5 %, *i. e.*, little less than those contained in crude maize. Sorghum, as in maize these substances hinder the solution of the starch, thus accounting for a yield in extract below that which might be expected from the proportion of starch it contains (62 to 66 %).

Sorghum fat also has the disadvantage of going rancid fairly quickly. It must, therefore, be taken to store the grain in good condition and to do nothing with any rancid smell, as this might be transmitted to the beer.

Most of the samples contain a fairly large amount of total protein; this would account for the rapid spoiling of over-damp grain. Most of this protein, however, is insoluble and, as in all crude grain, does not pass into the wort and can have no influence on the keeping quality of the beer.

Sorghum is used in the same way as maize and rice, *i. e.*, it is added during the first mashing or to the copper. It may be advantageously used in brewing. The only difficulty is that of filtering, which is attributed to the use of excessively fine meal, which must not exceed a certain degree of fineness. From the point of view of filtering, treatment during boiling is advantageous as it allows all the starch to be dissolved by dividing the cellulose of the grain into the smallest possible particles.

571 - **Microscopical Studies on Tomato Products** (1). -- HOWARD, BURTON J., in collaboration with STEPHENSON, CHARLES H., in *United States Department of Agriculture Bulletin* No. 581, pp. 24, 5 Fig., 12 Tables. Washington, October 6, 1917.

During the past few years the Bureau of Chemistry has conducted a very comprehensive investigation to establish a basis for judging tomato products. Experiments were conducted in the bureau laboratory and also in factories, a large number of which were visited. Out of the mass of data thus collected, it was felt that the scientific facts underlying the relationship between microorganisms and the rot and decay of tomato products should be of value to manufacturers and food control officials at the present time. The results bearing upon the relation of the physical condition of the stock from which tomato products are made to the number of microorganisms present in tomato products are therefore given in this bulletin.

A great many tests at factories were made by noting the general condition of the stock and then examining microscopically samples of the finished products. The criteria published in 1911 in the Bureau of Chemistry Circular 68, for the guidance of manufacturers, were reached largely by such experiments.

Tomato products promptly made from stock judged acceptable by visual inspection never showed high counts of microorganisms. Similarly products made from stock obviously not good or from stock improperly handled usually showed high counts. It may therefore be assumed that high counts of organisms in such products indicate unmistakably that the stock used was in bad condition or was handled in an insanitary manner during manufacture.

It was found that tomato pulp stored in barrels usually gave high microscopical counts; hence it would seem inadvisable to use barrels for storing the product.

Field work performed during the past three seasons has proved that with proper equipment and factory management there is no reason for stock ready for the cyclone to contain over 1 per cent of decayed material.

In factories where the stock is properly handled the mould count is of greater importance than the counts of the other organisms in judging the condition of the raw stock. High counts of yeasts and spores, and bacteria are more frequently an indication of secondary than of primary spoilage. A low mould, yeast and spore or bacterial count does not necessarily indicate sound stock, but a high count in any of these organisms always indicates bad stock or improper handling.

It was found that, of the samples made in the laboratory, none with less than 5.5 per cent of rot gave a mould count of more than 50 per cent of microscopical fields. In the case of the factory samples the mould count rose sharply from 0 to $\frac{1}{2}$ per cent of rot. Beyond $\frac{1}{2}$ per cent the rate of rise gradually decreases, until after 20 per cent of rot the rate of increase is slow. A mould count of 40 may be obtained in samples having any amount of rot between 2.2 and 100 per cent.

(1) See also *R.*, September 1917, No. 856. (Ed.)

A yeast and spore count of 20 per $1/60$ cm. represents about 1 per cent of decay. From this point the rate of increase is slow.

A bacterial count below 15 000 000 per cc. indicates little as to the amount of decay. Beyond this point, however, up to 20 per cent of rot the rate of increase is about 20 000 000 for each per cent. of rot.

An investigation of the manufacture of tomato sauces and pastes in Italy showed that Italian products should be equal to American products made under similar conditions. The mould count for the concentrated products was found to be about the same as that for pulp, and the yeast spore and bacterial counts to be proportional to the degree of concentration. Sauces and pastes made from objectionable material run particularly high in yeasts, spores and bacteria. High counts on this class of products, then, indicate bad stock or insanitary handling.

572 - **The Importance of Bacterial Action in Indigo Manufacture.** — HUTCHINSON, C. M. (Imperial Agricultural Bacteriologist, Fusa), pp. 11. Calcutta 1917.

As the result of investigations carried out in the Imperial Laboratory during 1916 in conjunction with the Indigo Research Chemist, it has become apparent that the yield of indigo from a given weight of indigo plant depends upon the intervention of bacteria during the steeping process. The account of the work done on this subject is intended to give some idea of the manner in which this fact has been ascertained, the extent to which it is probable that bacterial action affects yield, and the possible ways of making use of this new piece of information so as to successfully modify existing factory practice. It is remarkable that so far as published records are concerned, no previous work on these lines has apparently been done in India, as the obviously bacterial nature of the fermentation process going on in the steeping vat would naturally suggest investigation into the action of such bacteria upon the plant and upon the important part of it which goes into solution in the water.

The chief conclusions reached in the present study are as follows:—

- 1) The yield of indigo depends largely upon bacterial action.
- 2) Some kinds of bacteria operate beneficially, others detrimentally. In the absence of the former class in sufficient numbers there will be a reduction in yield.
- 3) It should be possible to ensure the presence of the beneficial kinds by artificial inoculation.
- 4) It is necessary to bring the bacteria normally present on the walls of the steeping vat into closer contact with the indigo plant in the vat, by altering the shape of the latter so as to reduce the ratio of cubic content to wall area.
- 5) It will probably be found beneficial to modify the character of the wall surface so as to promote more extensive and permanent growth of the beneficial bacteria.

573 - **The Use of *Imperata cylindrica* in Paper Making; Experiments in Italy.** — VIGNOLO-LITATI, FERDINANDO, in *Annali della R. Accademia d'Agricoltura di Torino*, Vol. LVIII, 1915, pp. 68-76. Turin, 1916.

Since 1913 (*L'Industria chimica*, Nos. 2 and 13, Turin, 1913), the author, attached to the Chemical Laboratory of Commercial Products at the

Royal Institute of Commerce of Turin, has carried out laboratory experiments and industrial investigations into the utilisation of *Imperata cylindrica* as raw material in paper-making. In his laboratory experiments he treated the leaves by the soda method; in the industrial experiments the calcium bisulphite method was used. The results obtained in the laboratory experiments led to the conclusion that:— 1) under normal pressure the cellulose (which is easily bleached by the ordinary methods) may be extracted from *I. cylindrica* without difficulty in quantities amounting to 40 % of air-dried raw material; 2) the fibre of *Imperata*, *Stipa* and *Lygeum* are very similar. From the results obtained in the industrial investigations it may be concluded that:— 1) the cellulose of *I. cylindrica* is very similar to that of esparto grass; 2) the yield of bleached cellulose may amount to 38 %; 3) no greater consumption of chemicals is required to reduce to paper pulp the cellulose of *Imperata* than to reduce that of esparto.

In the industrial experiments the soda method was tested with the following results:—

The best conditions for obtaining an easily bleached pulp are realised by using the autoclave under a pressure of from 2 to 3 atmospheres and caustic soda in quantities not less than 10 % of the air-dried raw material. An excess of soda facilitates bleaching but reduces the pulp yield. The yield is higher with low pressure (1 to 2 atmospheres) and prolonged boiling than with greater pressure and shorter boiling. The crude fibre obtained with 10 to 15 % caustic soda contains a high proportion of slimy substances which are largely removed by prolonged washing. By the use of 10.6 % of soda and 6 hours' boiling under a pressure of 3 atmospheres, 37 % of crude fibre is obtained. If this is treated with 15 % calcium chloride (containing 33 % free chlorine), a satisfactory white fibre is obtained. If a larger quantity (15.9 %) of caustic soda is used under the same conditions of boiling and pressure, the yield is slightly less, and, when treated with 12.4 % of calcium chloride, a perfectly white fibre is obtained. The yield of bleached fibre is thereby raised to about 35 %, but if normal pressure is used the yield is from 39 to 40 %.

The stems (70-80 cm. long, 3-4 mm. in diameter at the lower internodes and about 2 mm. at the upper internodes; water content about 11 % when air-dried), stripped of their nodes, chopped and crushed, then treated by the methods used for the leaves, give about 45 % of bleached cellulose.

According to HACHEL there are 3 varieties of *I. cylindrica*:—

- 1) a) var. *genuina* sub-var. *europaea*, growing on the sandy shores of rivers and the sea throughout the Mediterranean district, and even as far as the Sahara and Caspian Sea;
- b) var. *genuina* sub-var. *Thunbergii*, of central and southern Africa;
- 2) var. *condensata*, of Chili;
- 3) var. *Koenigii*, of East Africa and southern and eastern Asia.

In his experiments the author used *I. cylindrica* var. *genuina* sub-var. *europaea*. In certain districts varieties of *Imperata* have been of great service in fixing moving sands and in fighting the desert. For this reason when these plants are to be used in such districts for paper-pulp they should be cut and not uprooted, so as not to injure growth.

In Italy *I. cylindrica* grows mostly on the southern Tyrrhenian coast, the Ionian coast, and in the islands. In Calabria it is often found as a pest, infesting the olive-orchards in particular. In this last case harvesting and using it would not only improve olive growing, but would also form a source of income.

4 - **Dairy Inspection in the United States.** — BAILEY W. H., in the *Journal of the American Veterinary Medical Association*, [Vol. LII, No. 6, pp. 686-692, Ithaca, N. Y., February, 1918].

INDUSTRIES
DEPENDING
ON ANIMAL
PRODUCTS

In this address delivered at the 54th Annual Meeting of the American Veterinary Medical Association, the following points were discussed: 1) Healthy Cattle; 2) The Importance of Clean Milking Methods, Cooling, Transportation and Distribution Methods; 3) Pasteurization.

The following points were emphasized concerning the value of close regulation of dairy and milk inspection: —

a) Milk produced under filthy conditions may possess a low bacterial count if it is instantly and constantly cooled to 50° F. or below.

b) Milk produced under sanitary conditions may possess a high bacterial count at the time of distribution, if it has not been cooled and maintained at proper temperature.

c) A high scoring dairy may, at times, produce a badly contaminated milk, while a dairy scoring very low may produce clean milk.

d) Thus careful inspection of gross conditions and the rating of milk value in terms of per cent. on the government score card, together with milk inspection, particularly bacterial analysis, will enable any health department to judge its milk supply correctly.

The establishment of a government milk hygiene service for the control and regulation of milk production throughout the United States is advocated.

5 - **The Daily per Capita Consumption of Milk in the United States (Connecticut).** — JENNINGS, H. F., *Journal of Dairy Science*, Vol. I, No. 3, pp. 246-249, Baltimore, September, 1917.

While it is difficult to compile any accurate figures on the daily per capita consumption of milk, it is generally conceded that the average for the United States is about 0.6 of a pint. This is a little more than a glass a day. That this is too small an amount is beyond question considering it from the standpoint of protein, which is especially needed by the growing child, or from the standpoint of total energy as utilized by the adult, when more food value is obtainable from milk for a given sum of money than can be purchased in any comparable food.

The following table recently prepared by the United States Department of Agriculture illustrates this point: —

Protein.	Energy.
1 quart of milk is equal to:	1 quart of milk is equal to:
7 ounces of sirloin steak	11 ounces of sirloin steak
6 ounces of round steak	12 ounces of round steak
4.3 eggs	8 ½ eggs
8.5 ounces of fowl	10.7 ounces of fowl.

[513-575]

Were it not for the infant the per capita consumption would be much less than it is. According to Vermont Bulletin 195 one sixth of the milk produced by 22 000 000 cows is used as a food for infants and young children. It has been figured that an infant consumes 530 quarts of milk during the first year of its life.

In order to study the per capita consumption of milk first hand data were tabulated from families living in Storrs to whom the Connecticut Agricultural College retails daily about 90 quarts and hence accurate records were available.

The families were divided into three groups : —

GROUP I.

Families with one or more children under three years.

	Number of days	Number of pints	Average daily consumption	Number in family	Average per capi (pints)
Total	1 019	5 679	55.46	39	—
Average	101.9	567.9	5.546	3.9	1.4

GROUP II.

Families with children three to twelve years.

Total	586	1 780	18.02	24	—
Average	97.6	296.6	3.003	4	0.7

GROUP III.

Families with no children.

Total	873	1 517	19.72	2.3	—
Average	76.09	135.1	1.79	2.0	0.89
Average per 27 families	—	—	3.45	3.22	1.07

The per capita consumption of milk on 17 farms where it was produced resulted in 1.30 pints daily with considerable variation in different families.

576 — **Chemical Changes in the Souring of Milk.** — VAN SLYKE, LUCIUS L. and BOSWELL ALFRED W. (Chemical Laboratory of the New York Agricultural Experiment Station, Geneva), in *The Journal of Biological Chemistry*, Vol. XXIV, No. 3, pp. 191-202, Baltimore, Md., 1916.

Fresh milk was analyzed for its soluble and insoluble constituents, a porous porcelain filter being used to make separation. Another portion of the same milk was inoculated with a culture containing *Bacterium lactis acidii* and *Bacterium lactis aerogenes*. At the end of 60 hours determinations were made of the soluble and insoluble portions. About 22 per cent of the milk-sugar was changed by the lactic acid bacteria, 88.5 per cent of the amount changed being converted into lactic acid. Citric acid completely disappeared.

The insoluble inorganic constituents of the fresh milk were made soluble by the lactic acid. Albumin of sour milk passed through the

retain filter completely. Calcium caseinate was changed into free protein and precipitated, the calcium forming lactate.

To study the rate and extent of chemical change under given conditions, sterilized, pasteurized, separated skim-milk was inoculated with a pure culture of *Bacterium lactis acidii* and kept at 32.2° C. Samples were taken for analysis at intervals during 96 hours. Most of the change in milk-sugar occurred between the 10th and 24th hours. When the milk contained 0.7 per cent lactic acid, the bacterial activity was much reduced. The acidity increased rapidly during the first 24 hours, the rate of increase diminishing thereafter. The increased acidity of the serum was due to increase of lactic acid. In the insoluble portion of the milk the free casein is the acid constituent. Calcium combined as CaHPO_4 goes into solution completely in 13 1/2 hours. Calcium combined as caseinate was acted upon more slowly, complete solution requiring about 24 hours. The amount of albumin nitrogen in the serum increased with increase of acidity; all the albumin of the milk appears in the serum in 14 hours.

7 - Studies on Goat's Milk. — I. The Casein of Goat's Milk: II. The Soluble and Insoluble Compounds of Goat's Milk. — BOSWORTH, ALFRED W. and VAN SLYKE, LOECUS L., in *The Journal of Biological Chemistry*, Vol. XX, 3, pp. 173-175; 177-185. Baltimore, Md., 1916.

I. — On the basis of the analytical results obtained in the study of the compounds formed by casein of goat's milk with bases, taken together with the amount of phosphorus and sulphur found in such casein, the molecular weight is 8 888 and the valency of the protein molecule in basic caseinates is 8.

II. — Goat's milk contains two general classes of compounds, those in true solution and those in suspension or colloidal solution. These two portions can be separated for study by filtering milk through a porous earthenware filter like the PASTEUR-CHAMBERLAND filtering tube.

Serum prepared from fresh milk of goats is nearly transparent, with a faint greenish-yellow tinge and slight opalescence. The following constituents are in true solution: sugar, potassium, sodium, chlorine. The following are partly in solution and partly in suspension or colloidal solution: albumin, inorganic phosphates, calcium, magnesium, citrates. The following are entirely in suspension or colloidal solution: fat, casein.

The insoluble portion of milk, freshly prepared and moist, is grayish to greenish-white in colour, of a glistening appearance, and of gelatinous consistency. When shaken with water, it goes into suspension, forming a mixture giving the opaque, white appearance of milk. Such a suspension is neutral to phenolphthalein. When purified, the insoluble portion consists of neutral calcium caseinate (Casein Ca_4), di- and tri-calcium and magnesium phosphates.

The insoluble portion, suspended in water and treated with neutral potassium oxalate, reacts alkaline to phenolphthalein, indicating the presence of tri-calcium phosphate. This is shown also by a quantitative comparison of the amount of bases and acids.

The acidity of the serum is considerably greater than that shown by the milk after treatment with neutral calcium oxalate. This is accounted for by the presence of di-calcium phosphate.

The following arrangement is tentatively suggested as representing the forms in which the constituents of goat's milk may be present:—

	per cent
Fat	3.80
Proteins, combined with calcium	3.10
Milk sugar	4.50
Salts:	0.94
Di-calcium phosphate	0.092 per cent.
Tri-calcium phosphate	0.062
Di-magnesium phosphate	0.068
Tri-magnesium phosphate	0.024
Mono-potassium phosphate	0.073
Potassium citrate	0.250
Potassium chloride	0.160
Calcium chloride	0.115
Sodium chloride	0.095
Total solids	12.34

578 - A Comparison of the Composition of Cow's Milk, Goat's Milk, and Human Milk. — BOSWORTH, ALFRED W. and VAN SLYKE, LUCIUS L. (Chemical Laboratory of New York State Agricultural Experiment Station, Geneva), in *The Journal of Biological Chemistry*, Vol. XXIV, No. 3, pp. 187-189. Baltimore, Md., 1916.

The authors have published statements attempting to indicate individual forms or compounds in which the salts exist in cow's milk (1), goat's milk (2) and human milk (3). It is a matter of interest to bring the results together in order to see in what respects the three kinds of milk differ. In the appended table the figures which have a special interest are those relating to the salts, and we notice the following points in relation to the compounds.

PHOSPHATES. Cow's Milk. — The insoluble phosphate is di-calcium phosphate; tri-calcium, di- and tri-magnesium phosphates do not appear to be present. The soluble phosphates are mono-magnesium and di-potassium which constitute about two-thirds of the total phosphates.

Goat's Milk. — This differs from cow's milk (1) in containing tri-calcium, di- and tri-magnesium and mono-potassium phosphates, and (2) in containing no mono-magnesium or di-potassium phosphates.

Human milk. — This differs noticeably from both cow's milk and goat's milk in containing no insoluble phosphates, but only the soluble compounds mono-magnesium and mono-potassium phosphates. The phosphates of human milk are much less in amount than in cow's or goat's milk.

CITRATES. All three milks contain potassium citrate, while cow's and human milk contain sodium citrate also.

CHLORIDES. Chlorides are present in goat's milk in much larger amount

(1) See *B. May* 1915, No. 548. (2) See No. 577 of this Review. — (3) See: *The Journal of Biological Chemistry*, Vol. XX, pp. 707-709, 1915. (Ed.)

in cow's milk or human milk; the amount in cow's milk is considerably greater than in human milk. In cow's milk and human milk the chloride appears to be calcium chloride, while in goat's milk potassium and sodium chloride are also present.

TOTAL SALTS. The total amount of salts in human milk is about one-third that of cow's milk or goat's milk. The number of different salts appears to be greatest in goat's milk and least in human milk.

Compounds in Cow's Milk, Goat's Milk, and Human Milk.

Compounds	Cow's Milk per cent	Goat's Milk per cent	Human Milk per cent
lactose	3.90	3.80	3.30
lactogen	4.90	4.50	6.50
proteins, combined with calcium	3.20	3.10	1.50
histidine	0.901	0.939	0.313
calcium phosphate	0.175	0.092	0.000
free calcium	0.000	0.062	0.000
magnesium	0.103	0.000	0.027
magnesium	0.000	0.008	0.000
magnesium	0.000	0.024	0.000
potassium	0.000	0.073	0.069
potassium	0.230	0.000	0.000
sodium citrate	0.052	0.250	0.103
sodium	0.222	0.000	0.055
sodium chloride	0.000	0.160	0.000
sodium	0.000	0.095	0.000
sodium	0.119	0.115	0.059

Pasteurization of Cream.—LARSEN, C., FULLER, J. M., JONES, V. R., GREGORY, H. and TOLSTRUP, M., in *Agricultural Experiment Station, South Dakota State College of Agriculture and Mechanic Arts, Dairy Husbandry Department, Bulletin No. 171*, pp. 529-548. Tables. Huron, S. D., November, 1916.

Some European countries have required for some time that all butter made from pasteurized cream. In the United States about $\frac{2}{3}$ of the cream is now made from pasteurized cream, and pasteurization of cream for butter making is constantly increasing.

The chief purposes of the writers' experiments were:— 1) to ascertain the efficiency of the coil cream vat for pasteurization of cream; 2) to determine the effect of different temperatures of cream pasteurization upon: a) cream content of cream; b) chemical composition of cream; c) size and distribution of butterfat globules in cream; d) keeping qualities and acidity of butter manufactured.

The equipment consisted in a 150 gallon coil cream vat, a 20 HP reboiling tubular boiler and a 15 HP engine which ran the coil in the cream vat. The cream was of uniform good quality and contained 30 per cent butterfat.

When the steam pressure reached 73 lb., the coil in the vat was started running 10 minutes at the speed of 42 to 45 revolutions per minute. After mixing the cream, samples were taken for chemical and bacteriological

logical analysis and for measurement of fat globules. The temperatures of pasteurization were as follows: — in one series of experiments the cream was heated to 140° F for 25 minutes; in a second series to 160° F for 10 minutes; in a third series it was heated to 180° F and cooled immediately. Subsequently the cream was cooled to ripening temperature, or about 75° F; after cooling samples were again taken for chemical and bacteriological analysis and measurement of fat globules; 8 to 12 % of starter was added, and each of cream ripened as nearly as possible to the same acidity. The percentage of acid developed in the cream varied from 0.45 to 0.55. After ripening which required from 2 to 6 hours, the cream was cooled to a few degrees below churning temperature (52° to 56° F.), held from 1 to 2 hours and then churned. A sample of butter from each churning was placed in cold storage (at about 40° F); the acidity and score of the butter was determined when the butter was fresh and at the end of 1, 2 and 3 months.

The results may be summarized as follows: —

It was found that in pasteurization of cream at different temperatures, namely, 140° F. for 25 minutes, 160° F. for 10 minutes and 180° F., with immediate cooling, the temperature of 160° F. for 10 minutes was the most effective in destroying total micro-organisms. Pasteurization of cream at 160° or 180° F. proved more efficient in killing moulds and non-acid forming organisms than pasteurization at 140° F.

The only noticeable change in composition of cream due to pasteurization was a slight decrease in percentage of water, and a consequent increase in percentage of total solids.

There was a slight decrease in acidity of the cream after pasteurization at temperatures of 140° and 160° F. Cream pasteurized at 180° F. showed on the average less decrease in percentage of acid. This is probably due to the fact that the decrease in acidity by volatilization of acids just about offsets the increase in acidity through evaporation of water from the cream.

Numerous microscopical examinations of fat globules in raw and pasteurized cream show that at the higher temperature (160° and 180° F.) fat globules tend to coalesce or unite. This is probably due to the high heat, together with the greater agitation of the cream by the coil.

In no instance was it noticed that the high pasteurization temperature unfavourably affected the body of the butter.

Butter made from cream pasteurized at 180° F. retained its keeping qualities the best.

The different temperatures of pasteurization did not have any important effect on the chemical composition of the butter.

580 — Concerning Rancidity of Butter. — GUTHRIE, E. S. (Department of Dairy Industry, Cornell University), in *Journal of Dairy Science*, Vol. I, No. 3, pp. 218-233. Bulletin September, 1917.

The plan of research of the investigations, concerning rancidity of butter, reported in this paper, was outlined as follows: — Is rancidity due to chemical, cow enzymic, or biological changes? On account of lack of time to study all the factors, the first two changes were the only ones investigated.

So long as most of the previous investigators thought that oxidation

the main consideration in the development of rancidity, the chemical changes were studied with special reference to the iodine number.

The chemical changes in butter were found to be very slight when biological agencies were held in check. These changes did not cause rancidity. The enzymic development caused very little variation in the iodine number, and it produced no rancidity.

The exposure of butter and butter fat to high temperatures, light and air, did not cause a marked change in the iodine number, and this exposure did not cause rancidity. Rancidity of butter as defined by butter dealers and expert butter judges is rarely found. The average person thinks of a strong flavour of butter as rancid.

A bibliography on the subject is appended.

1. - **Indole and Scatole in Cheese.** — NELSON, V. E. (Laboratory of Agricultural Chemistry of the University of Wisconsin, Madison), in *The Journal of Biological Chemistry* Vol. XXIV, No. 4, pp. 533-536. Baltimore, Md. 1916.

In attempting to isolate certain amines and other decomposition products resulting from the action of various microorganisms upon amino-acids and in cheese, the author observed that Limburger and "Handkäse" contain a considerable amount of indole and that the former also contains an appreciable quantity of phenolic bodies. This led to a study of other varieties of both soft and hard cheese, to determine whether they contained such substances as indole, scatole and phenol.

The method of procedure was to macerate about 400 gm. of cheese with water, place the mixture in a 5 litre flask, and distil with steam. To the distillate were applied tests for the detection of indole, scatole, phenol and ammonia. The results were as follows: —

Indole and phenol were found to be present in Limburger cheese. Scatole was not found in Limburger cheese. Indole is present in Handkäse. It is doubtful if scatole and phenol are to be found in this type of cheese. A trace of indole is present in Camembert cheese. Scatole and phenol are absent in this type of cheese. Cheddar, Swiss, Gammasost, brick, and Roquefort do not contain any indole, scatole, or phenolic bodies.

The amount of indole in a Limburger cheese naturally varies, depending upon how far the ripening process has gone. A young cheese may contain such a small amount that a quantitative estimation is impossible, while a good ripe Limburger cheese may contain as much as one part in 52 800 parts of cheese.

Lactic and bulgaricus forms of organisms when grown upon media containing tryptophane produced no indole or scatole. As growing organisms upon pure amino-acids is more difficult than upon proteins it may be necessary to add a little peptone or milk to the culture and until further work has done upon this phase it will be impossible to say that these organisms do not produce these putrefactive substances.

The liquefying coccus isolated from a Cheddar cheese appears to produce traces of indole from tryptophane.

582 — **Cheese Mites.** — EALES, NELLIE B., in *The Journal of the Board of Agriculture*, Vol. XXIV, No. 10, pp. 1087-1096. London, January, 1918.

The experiments described were carried out at the Zoology Department of University College, Reading, as a result of the great damage done by mites to cheeses in England. Four species of mites attack cheese: — 1) *Carpoglyphus anomus* (in Cheddar); 2) *Tyroglyphus siro* (in Stilton and Cheddar); 3) *T. longior* (*id.*); 4) *Aleurobius jarinae* (*id.*).

The mites, their life history, and the experiments made on cheese infection are described, and methods of prevention and remedies given.

Methods of prevention. — 1) Perfect cleanliness of the rooms in which cheeses are kept, and of all utensils and shelves used, the stopping up of crevices and crevices, etc.

2) Netting of windows and double doors.

3) Thorough disinfection of the rooms between the Stilton season the whole room, especially all corners, window ledges, crevices, shelves and their supports, etc. should be washed with a 5 % carbolic acid solution.

4) It would be advisable to use short, movable shelves, preferably glass, with iron supports and to have concrete floors with gutters and drainage.

Remedies. — 1) Filling the cheese room with steam vapour, and dipping the cheeses in hot water or formalin are useless as remedies.

2) Brushing the attacked cheeses daily and removing the mite dust considerably reduce the damage.

3) Fumigate the room with carbon bisulphide in the proportion of 1 lb. of bisulphide to every 500 cubic feet of space during August or September; there should be at least two fumigations, the second 12 or 14 days after the first, a third after the same interval is advisable. Painting the surface of the cheeses with bisulphide is the only way of freeing them entirely from mites; three paintings should be applied.

583 — **The Handling and Precooling of Florida Lettuce and Celery** (1). — RAMSEY, H. and MARKELL, E. L., in the *U. S. Department of Agriculture, Bulletin No. 60*, pp. 25-7. Tables + 19 Figs. Washington, December 21, 1917.

In Florida the cultivation of lettuce and celery, now being grown on 4 000 acres, an area which is constantly increasing, brings into the growers about 1 500 000 dollars annually. As rot frequently causes serious loss not only in the field, but also in apparently sound produce during transit the Office of Horticultural and Pomological Investigations of the Bureau of Plant Industry of the U. S. Department of Agriculture undertook a series of investigations into the best commercial methods for reducing the loss which occur from the time the produce leaves the field till it is delivered to the consumer.

The experiments on lettuce were carried out in 1913-1915 near Palmetto, Manatee County, one of the largest lettuce-producing centres in Florida, those on celery at Palmetto and Manatee, chiefly during the spring of 1915. The rotting of lettuce during transport was found to be due primarily to the action of the mites.

(1) See R. Jan., 1918, No. 100. (*Ed.*).

ally to lettuce drop (*Sclerotinia Libertiana*), a fungus which seems to enter the lettuce through the lower leaves.

The lettuce was cut just above the lowest 3 or 4 leaves, and all diseased leaves removed; such lettuce decayed much less during transit than that cut by the ordinary method. Produce in cars pre-cooled at the shipping point to 40°F. decayed much less during the journey than that in cars that had not been pre-cooled. Lettuce cut as described and packed in pre-cooled cars reached its destination in almost perfect condition and was much better than that treated by the usual methods.

Celery is often injured in transit because it is packed too closely in the car to permit of proper circulation of the air and rapid cooling. Temperature records taken during transit in pre-cooled cars iced at the station and non-pre-cooled cars kept iced throughout the journey, showed that non-pre-cooled cars required about 4 days to reach as low an average temperature as that maintained by pre-cooled cars from the start. During the whole journey from Florida to the destination (New York) the temperature in the top row of cases never exceeded that in the lowest row by more than 5 or 6°F. in the pre-cooled cars, whereas in the non pre-cooled cars it amounted to 8°F. for a considerable time.

The cost of the pre-cooling and initial icing of a car of celery was less than that of full refrigeration throughout the journey. In hot weather it may be necessary to renew the ice once during transit, but this is not likely to raise the expense above that usually incurred for full refrigeration.

Pre-cooled celery reached the market in uniformly fresh condition, with the leaves of the top row almost as green as those of the lowest rows. The leaves in the top rows of non-pre-cooled celery were very yellow, decreasing the value of the whole load.

It appears that, during the latter part of the Florida celery-shipping season, the produce might be sold at a better price if stored for a short time. Pre-cooled celery was successfully stored during 4 weeks with very little decay, whereas non pre-cooled celery stored during the same time decayed considerably. Celery from the lower rows of a non pre-cooled car can be stored for a short time, but, during warm weather, that on the top row could be sold as soon as it reaches the market.

PLANT DISEASES

DISEASES NOT DUE TO PARASITES OR OF UNKNOWN ORIGIN.

584 - Observations on the Damage Done to Trees by Tarring the Streets of Milan (1). — BRIZI, U., in *Reale Istituto Lombardo di Scienze e Lettere, Rendiconti*, series 2, Vol. L, Pt. 12-13, pp. 568-591. Milan, 1917.

As had already been noticed in France, England, and even in Italy the author observed that tarring roads causes the death of the plants on them. Many of the observations made at Milan agree with those previously made, as regards both trees and plants in beds bordering on the tarred roads.

The most sensitive plants are *Æsculus Hippocastanum* and *Æsc. glabra* (= *Æsc. glabra*) the leaves of which, at the beginning of summer, turn rusty at the edge and curl up slightly, while their surface is covered with numerous small spots, which, at first, are yellow and as if covered with a thin layer of shining varnish. The leaf then curls up more and more, dries and is easily torn and carried away by the wind.

Other conditions being equal *Platanus orientalis* is more resistant. In late summer the leaves, particularly the youngest and those of the lower branches, are sprinkled with yellowish spots, which later turn into small brownish, confluent marks with a shiny surface. The leaf is rarely completely covered with these spots, and, for that reason, does not often curl up altogether and fall.

Very sensitive are *Forsythia viridissima*, *Fagus laciniata* (= *F. sylvatica*), *Lagerstræmia indica*, *Taxus baccata*, *Spiræa solstitialis* (?), *Cornus*, *Dent.*

(1) See *B.* Dec., 1910, p. 391; *B.* Jan., 1911, Nos. 281 and 282; *B.* Feb., 1911, No. 1; *B.* May, 1911, No. 1522; *B.* July, 1911, No. 2271; *B.* Nov.-Dec., 1911, No. 3227; *B.* June, 1912, No. 967; *B.* Feb., 1913, No. 184; *B.* May, 1913, No. 522. (Ed.)

agnolia granatiflora, etc., and, of the herbaceous plants, *Lamium*, *Stellaria*,
 2. Field grasses are more resistant.

The injury is caused almost exclusively by the very fine dust raised by the passage of motor cars along the tarred roads. This dust settles slowly and is most abundant on low plants and the lowest branches of trees, and is abundant on high branches. This was confirmed by a set of experiments on both herbaceous and woody plants (*Chrysanthemum*, *Primula sinensis*, *Geranium*, *Dahlia variabilis*, *Fuchsia*, *Canna indica*, *Pelargonium zonale*, *Prunum vulgare*, *Lolium*, *Festuca*, *Aloë margaritifera* (= *Haworthia margaritifera*), *Echeveria metallica* (= *Cotyledon gibbiflora*), *Crassula*, *Nephrodium*, *Hydrangea*, *Forsythia viridissima*, *Syringa vulgaris*, *Spiraea solstitialis* (?), *Esculus*, *Fagus purpurea*, *Tilia*, *Ulmus effusa*, *Acer pseudoplatanus*, *A. Negundo* (= *Negundo aceroides*), *Phoenix*, *Trachycarpus*, *Kentia*, *Pinus nobilis*, *Thuja*, *Cupressus*, *Araucaria*, *Platanus orientalis*).

The harmful action of the dust is due, if not exclusively, at least largely, to the action of the vapours given off by the small particles of tar it contains when it is strongly heated by the sun. No other explanation can be given for the fact, observed in nature, and absolutely clear and indisputable in the experimental tests, that on the same plants, covered with the same amount of dust of the same quality, marked and serious lesions occur only in the parts exposed by the sun and are more intense and rapid in growth in proportion to the period of insolation is prolonged, and, consequently, the temperature is higher. Plants exposed in the shade, or not reached directly by the sun, suffer no perceptible injury. The soluble compounds contained in the particles of tar cannot be considered to be direct causes of the injury, firstly because these particles are insoluble, and, secondly, because even some injurious substances could be dissolved by rain, this would not explain why the lesions only appear in the parts exposed to the sun. On the other hand, rain, though only light is favourable, because it washes the plants free from dust.

The best remedy lies in a rational, regular and abundant watering of the tarred roads, which would remove the dust, especially when it accumulates during long droughts. It is probable that the slight damage hitherto observed in England is due, not only to the use of a better quality tar—it is not the case in France from the gas-works as in France and Italy, but a special refined tar—but to the fact that all the tarred roads on which there is much traffic are not only watered daily, but are well washed by powerful streams of water which prevent the dust from accumulating. Care should also be taken to choose for shaded roads trees or plants little subject to the action of tar.

To avoid serious injury when the boiling tar is applied the operation should be carried out by preference during the period of vegetative rest, or before the plants begin to grow, *i. e.*, at the beginning of spring, never in the middle of summer. By these means and by copious periodical watering the damage may be considerably reduced, but doubtless the only way to avoid it altogether is to replace tarring by another method of coating roads. At Milan it was observed that the use of asphalt or "San Valentino" gives rise to none of the damage to plant life caused by tar.

DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

585 — **Rusts and Smuts Collected in New Mexico in 1916.** — STANDLEY, PAUL C., *Mycologia*, Vol. X, No. 1, pp. 34-42. Lancaster, Pa., January, 1918.

The list contains about 60 species of rusts and 5 species of smuts, collected chiefly by the author in August and September, 1916, at Ute Park, Colfax County, in the extreme north of New Mexico, at an altitude of about 2 350 metres. Many of the species are new to the State, several others were found on hosts hitherto unreported for New Mexico. The rusts were determined by Dr. J. C. ARTHUR, the smuts by Mr. H. R. Rosen.

Among the rusts are *Colcosporium ribicola* (Cooke and Ellis) Arth. (*Peridermium ribicola* Long), very abundant on *Ribes aureum* Pursh. *R. inebrians* Lindl. and *Grossularia inermis* (Rydb.) Cov. and Britt. are new hosts for the State. The fungus was also found at Ute Park on a leaf of *R. Wolfii* Rothr. In the North American flora this rust is reported neither on *G. inermis* nor on *R. Wolfii*. LONG reported its aecidial stage on *Pinus edulis* Engelm., from the Sandia Mountains. He also reported the cleistothecial stage on *R. mescalecium* Coville, in the Santa Fe National Forest; the host was probably rather *R. inebrians*, because according to the author *R. mescalecium* is confined to the south of the State. LONG also noted a cleistothecial stage in Albuquerque on *R. longifolium* (*longiflorum* ?), a name which should doubtless be corrected to *R. aureum*; *R. longiflorum* is not known to occur in New Mexico.

Among the smuts are mentioned *Ustilago Hordei* (Pers.) Kell. and Swingle on cultivated *Hordeum trifurcatum* Jacq., and *U. levis* abundant on cultivated oats.

586 — **Brazilian Fungi** (1). — RANGEL, E., in *Archivos do Jardim Botânico do Rio de Janeiro*, Vol. II, pp. 69-71 + 3 Plates. Rio de Janeiro, 1918.

The list includes :—

- 1) *Puccinia graminumiae* Rangel n. sp., on living leaves of *Eragrostis brasiliensis*, in the Botanical Garden of Rio de Janeiro ;
- 2) *P. cambucae* Puttemans; the host of this fungus described previously is *Marlierea edulis*, not *Myrciaria plicato-costata* ;
- 3) *S. Simasii* Rangel n. sp., on leaves, petioles and twigs of *Begonia Burchellii*, at Icarahy, near Niteroy ;
- 4) *P. paulensis* Rangel n. sp., on leaves and twigs of *Capsicum annuum*, at S. Paulo ;
- 5) *Laestadia cambucae* Rangel; the host of this fungus is *Marlierea edulis*, not *Myrciaria plicato-costata* ;
- 6) *Septoria Miconiae* Rangel n. sp., on living leaves of *Miconia* at Niteroy ;

(1) See *B. Jan.*, 1912, No. 11; *B. June*, 1913, pp. 876-879; *B. Oct.*, 1913, No. 10; *B. Dec.*, 1913, No. 1407; *B. Jan.*, 1914, No. 78; *B. Aug.*, 1915, Nos. 850 and 861; *R. April*, 1915, No. 493. (Ed.).

7) *Cercospora Genipae* Rangel, n. sp., on living leaves of *Genipa G. americana?* at Rio de Janeiro;

8) *Helminthosporium Manihotis* Rangel, n. sp., on living leaves of *Manihot Aipi*, at S. João Nepomuceno (Minas Geraes);

In 1915 the author described a new genus of hyphomycetes, which he named *Vellosiella*; so as to avoid confusion with the similarly named genus of fulariaceae, he has changed the name of the genus he formed to *Myco-siella*.

A description of the species new to science is given in Latin.

- **Fungi of the Philippine Islands.** — YATES, H. S., in *The Philippine Journal of Science, Section C, Botany*, Vol. XII, No. 6, pp. 361-380, Manila, 1917.

This paper gives a list of 78 species of fungi collected during recent years in various districts of the Philippines. Many are new to science and, in his case, are accompanied by a description in Latin.

It is interesting to note that the genera *Meliola* and *Asterina* are particularly numerous. This may be explained in part by the fact that representatives of these two genera are mostly not very remarkable forms which have escaped previous investigators. In the Philippines the *Meliola* includes a larger number of known species than any other genus of fungi, second place in this respect being held by the genus *Asterina*. The list given by the author includes 21 species of *Meliola*, 17 of which are new to science, and 10 species of *Asterina*, 6 of which are new.

Among the various fungi enumerated are:—

- 1) *Meliola catubigensis* n. sp., on leaves of *Loranthus*;
- 2) *Asterina colliculosa* Speg., on leaves of *Eugenia Jambolana*;
- 3) *Actinodothis Piperis* Syd., on leaves of *Piper retrofractum* and other sp.; a fungus very common in the Philippines; in some places it attacks all the *Piper* plants are attacked;
- 4) *Cercospora personata* Syd., on leaves of *Arachis hypogaea* (1);
- 5) *Hadronema orbiculare* Syd., very common on living leaves of various sp.; it is one of the few fungi which have only been reported from Mindanao and the Philippines.

- **Plants Resistant to Diseases, Pests and Adverse Meteorological Conditions.** — See No. 570 of this Review.

- **Mineral Antieryptogamic Compounds Produced in Spain.** — See No. 500 of this Review.

- **Comparison of the Effects of Copper Mixtures and Acid Mixtures on Mildew of the Vine.** — CYRUS, J., in *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. IV, No. 2, pp. 80-90, Paris, 1918.

In 1917 the author undertook experiments in the experiment field of Illac (Gironde) and the laboratory of the Plant Pathology Station of the Department of Gironde, on the comparative effects of the following mixtures:—

RESISTANT
PLANTS

MEANS
OF PREVENTION
AND CONTROL

1) See R. March, 1917, No. 560 (F.L.)

- a) basic Bordeaux mixture, according to the formula of MILLARD and GAYON, with 2 % copper sulphate;
- b) acid Bordeaux mixture prepared by the PICKERING and SICARD method, with the same quantity of copper sulphate;
- c) basic Bordeaux mixture, prepared by PICKERING's method, i.e. with lime water and 2 % copper sulphate;
- d) acid Burgundy mixture, prepared by FONZES-DIACON's method;
- e) 2 % neutral Burgundy mixture.

The results obtained showed the acid and basic mixtures to be equally efficacious against mildew of the vine, but that for a period exceeding 20 days and during heavy rains, basic mixtures retain their efficacy better than acid ones.

591 - Patents for the Control of Diseases and Pests of Plants. — See No. 566 (44) Review.

592 - *Pseudomonas Tritici* n. sp., Injurious to Wheat in the Punjab. HUTCHINSON, C. M., in *Memoirs of the Department of Agriculture in India, Botanical Series*, Vol. 1, No. 7, pp. 160-175 + 4 Plates. Calcutta, October, 1917.

A bacterial disease of wheat, called locally "Tannan" or "Tandu" has long been known in the Punjab. Its principal characteristics are very similar to those described by RATHAY (1) and O'GARA (2) for *Dactyloctenium aegyptium* and *Agropyron Smithii* respectively.

The inflorescences and part of the stem are covered with a bright primrose yellow slime or gum, forming adherent, sticky layers between the glumes and between the stem and sheath. This slime is composed of masses of bacteria, and the outer, exposed parts become dry, hard and flaky, and at the same time, turn a deeper yellow. A frequent characteristic of the disease, due to obstruction of the growth of the plant by the sticky bacterial masses, is the distortion of the stem immediately below the head.

Although the disease has appeared in the same district (Montgomery of the Punjab) every year since 1908, with the sole exception of 1915, it is said to have been known there many years earlier, it does not appear to be of serious importance at present as it only attacks a very small percentage of plants, and only those in soil rendered infertile by bad cultivation and bad drainage.

The occurrence of the disease must, however, be carefully and continually observed to prevent an eventual increase of parasitic activity and a wider distribution of the pathogenic agent, although the disease seems present to be limited by natural causes — dry air and high soil temperature — to the only part of India in which it is as yet known. As the causes vary only in abnormal seasons, it seems that, in the Punjab, the disease would only form a serious obstacle to wheat-growing if the irrigation water were applied unjudiciously, or if a new variety of wheat, more subject to attack by the parasite, were introduced. The damage may also increase if the bacterium were to acquire higher parasitic power or resistance to adverse climatic conditions.

(1) See R. Nov., 1917, No. 109. — (2) See R. Feb., 1916, No. 242. (Ed.)

The disease may be spread either by bacteria persisting in the soil or by those carried on the grain or chaff of the plant; this should be remembered when using seed wheat from infected districts.

The causal bacterium is described in detail under the name of *Pseudomonas Tritici* n. sp. It is probable, as in similar cases, that eelworms play an important part in spreading or accentuating the disease.

In the inoculation experiments at Pusa bacterial growth on the wheat could only be obtained under a bell-jar, which ensured sufficiently moist air and the formation of dew on the plant. The rapid growth of the wheat, however, not only made it impossible to observe the full effect of the parasite, but appeared to prevent the characteristic distortion of the stem observed in the Punjab fields.

No positive results were obtained with inoculation of other Gramineae, but considerable bacterial growth was obtained on living onion bulbs. Onions were chosen because of the many points of resemblance in the morphological, cultural, and physiological characters of the wheat bacillus and *Ps. Hyacinthi* Wakker. The onion is the plant most closely resembling the hyacinth obtainable in the plains of East India.

In view of the relatively small percentage of wheat attacked by the disease, the only methods of control which need be emphasised for this as for other bacterial diseases of plants are good drainage and careful cultivation.

93 — **Bacterial Blight of Barley.** — JONES, L. R., JOHNSON, A. G. and REDDY, C. S., in the *Journal of Agricultural Research*, Vol. XI, No. 12, pp. 625-643 + 2 Figs. + 4 Plates. Washington, D. C., December, 17, 1917.

This paper describes a bacterial disease of barley (*Hordeum* spp.) which was first observed in 1912 doing considerable damage to two-row Montana barley (*H. distichon*), and later on common six-row varieties (*H. vulgare*), at Madison, Wis. Since then it has appeared each year in the same district and has also been reported from other parts of the United States.

The disease principally attacks the leaves, where it forms small water-soaked areas, which enlarge later into translucent yellowish or brownish blotches or stripes. Similar lesions may also appear on the glumes.

A bacterial exudate may appear on the lesions in the form of tiny, cloud-like drops, which harden into yellowish resinous granules or form a grayish sticky surface film. This exudate and translucency of the infected parts distinguish the bacterial blight from diseases caused by *Helminthosporium*. The disease is somewhat similar to those caused by *Aplanobacter Rathayii* F. S., *A. Agropyri* O'Gara, and *Pseudomonas Avenae* Manns, but is nevertheless distinct from each of them.

The primary lesions may appear very early on the young plants, and the secondary lesions when the plants are from 8 to 10 inches high, later the disease develops with increasing rapidity.

The disease is very widespread, from the Mississippi Valley to the Pacific coast. It attacks the two row (*H. distichon*), common six-row (*H. vulgare*), and erect six-row (*H. hexastichon*) barleys. The varieties of these three groups are not all equally susceptible to infection; some appear to be

naturally immune, but nothing definite can be stated till further work on the subject has been carried out

The pathogenic agent is present in great numbers in the invaded tissues and the exudate. It is a monotrichic bacterium, yellow in culture, which the authors believe to be new to science and describe under the name of *Bacterium translucens*. Not only has it been isolated from infected tissues and the exudate, but also from dry leaves, kept throughout the winter and from grain 2 years old.

Inoculation experiments have shown that the disease may easily be reproduced in barley by spraying with water containing the bacterium in suspension. Negative results were obtained by inoculations of oats, rye, wheat, spelt, emmer, einkorn and timothy. The bacterium enters the host through the stomates and intracellular spaces

Although the bacterium may hibernate in infected leaves there is no doubt that diseased grain is the principal factor in spreading the parasite and the seat of spring infection. The most efficacious means of control known at present consist in avoiding infected seed and in doubtful cases disinfecting it.

594 - **Diseases of Cabbage in the United States.** — HARTER, L. I. and JONES, L. R., in the *United States Department of Agriculture, Farmers' Bulletin* 925, pp. 30 + 13 figs Washington, D. C., January, 1918.

After observations on the spread of diseases of cabbages and other cultivated Cruciferae and the methods of controlling them, the author describes the most important of these diseases, nearly all of which are caused by vegetable parasites. They are:—

- 1) Clubroot (clubfoot, finger and toe), caused by *Plasmodiophora Brassicae* Wor.;
- 2) root-knot (*Heterodera radiculicola* [Greef] Müll.);
- 3) black-rot (brown-rot, stem-rot, dry-rot) caused by *Bacterium campestre* (Pammel) Erw. Sm.;
- 4) yellows (yellow-sides, wilt, dry-rot), caused by *Fusarium conglutinans* Wollenw.;
- 5) black-leg (foot-rot, wilt), a disease caused by *Phoma lingam* (Tode Desmar.;
- 6) soft-rot, caused by soft-rot bacteria, of which *Bacillus carotovorus* Jones is a typical example;
- 7) root-rot (wilt), a disease of non-bacterial origin caused by asphyxiation of the plant due to stagnant water;
- 8) malnutrition, a disease due to excess of chemical fertilisers and deficiency of humus in the soil;
- 9) downy mildew (*Peronospora parasitica* [Pers.] De By.);
- 10) white-rust (*Albugo candida* [Pers.] Ktz. = *Cystopus candida* [Pers.] Lev.);
- 11) drop (*Sclerotinia Libertiana* Fuck.);
- 12) spot disease of cauliflower, a new disease caused by a bacterium which appears to attack only *Brassica oleracea* and *B. oleracea* f. *Botrytis*;
- 13) black leaf-spot (black mould); the most common form of the

disease is caused by *Alternaria Brassicae* (Berk.) Sacc., but other related fungi may cause similar leaf-spotting, and yet others may contribute to moulding the plants in storage deposits;

14) powdery mildew (*Erysiphe Polygoni* D. C.);

15) damping-off, a disease which chiefly attacks young plants in seed-beds, and which may be caused by several species of fungi.

995 - *Pseudomonas seminum* n. sp., a Bacterium Injurious to Peas, in England.

— CAYLEY, DOROTHY M., in *The Journal of Agricultural Science*, Vol. VIII, Pt. 4, pp. 461-479 + Plates IV-VII. Cambridge, 1917.

Crops of *Pisum sativum* grown near the John Innes Horticultural Institution, Merton, Surrey, are badly damaged by a bacteriosis which, having appeared in a particularly serious form from 1910 to 1912, was found later in other districts in the south of England. The same disease was found in 1915 on peas from Sleaford, Lincoln. An examination of samples from various districts showed that this bacteriosis tends to spread more and more.

The author proposes to call the bacterium, which has not yet been described, *Pseudomonas seminum*, and gives details of its morphology and biology.

The chief characteristic of the disease is that it occurs within the seed, discolouring the centre of each cotyledon. External examination does not show if the seed is diseased or not. The bacteria cannot penetrate the ripe tissues, so that infection, found only in the lesions of the very young tissues, takes place long before it is shown by discolouration of the tissues.

The bacteria is found in all parts of the plant except the vessels, in which it has never been observed. It has been isolated from the interior of both the dry and fresh seed, from the stem and the pod. It has never been seen to pass the micropyle although, in one case, it was found in the space between the cotyledons and the young embryo.

All varieties of table peas seem more or less subject to the disease. The most resistant variety is Sutton's Improved Petit Pois, which when sown in infected soil, produced 40 to 50 % of sound plants, the seeds of which, sown in the same soil the following year, produced 50 % of sound plants. The Duke of Albany and Nec Plus Ultra varieties are very subject to the disease, the number of healthy plants in the first variety was, at the most, 14 to 15 %, and cultivation of the second at Merton for Mendelian experiments had to be stopped because of its great susceptibility. Tall, early varieties are much less attacked than late ones; this appears to be due to their less succulent vegetative apparatus, and their more rapid growth, which allows them to become sufficiently mature before external conditions determine a rapid development of the bacteria.

The author examined many varieties of early peas grown at Wisley in 1915. All the plants were nearly ripe. One variety only showed the typical discolouration of the cotyledons, although, judging by the external appearance, there were many doubtful cases. A row of Duke of Albany grown in an adjacent plot, but in a much more advanced stage of develop-

ment showed the typical discoloured area in the centre of the cotyledons. Infection was more marked at Merton than at Wisley, where it was probably introduced by seed.

Of the dwarf, succulent early varieties, Chelsea Gem and Little Marvel, and, of the later types, Nec Plus Ultra and Duke of Albany, are especially subject to the disease.

The bacteriosis does not stop germination, but, in serious cases, it delays the growth of the plant by killing the whole main stem and preventing the development of lateral shoots.

So far no means of controlling the disease are known. As precautions may be recommended crop rotation, early seed, drainage, a sufficiency of lime in the soil, elimination of seed from diseased plants. Infected plants and their props should be burnt as soon as the harvest is gathered. Partial sterilisation is of no use, and involves too much work and excessive expense. Special care should be taken to clean thoroughly all tools used in infested soil so that the disease may not be spread by them.

596 - *Verticillium albo-atrum* a Hyphomycete Causing "Vissnes Juka" (Wilt) of Cucumber in Sweden. — LINDBÖRS THORE, in *Kungl. Landbruks Akademiens Handlingar och Tidskrift*, Year LVII, Nos. 7-8, pp. 627-635 + 3 Figs. Stockholm, 1917.

In 1916, in a field of cucumbers at Ballersta, Södermanland, plants which were sound and strong till the end of July, were attacked by wilt of which the majority died. A microscopical examination of the infested material showed the existence within the stem tissues of masses of mycelium which more or less completely closed up the vessels, thus preventing the passage of the water from the roots. While the host lives the parasitic mycelium is restricted to the vascular bundles, and only invades the surrounding tissues after the death of the plant.

In cultures made from infested material 3 fungi were identified: - 1) *Verticillium albo-atrum*; 2) *Ascochyta Cucumis*; 3) *Fusarium nivium* (?); one case only and even then it was not possible to isolate it.

The following results were obtained from infection experiments, in which *Fusarium sclerotioides* and *F. redolens* var. *angustius* were used in place of the allied *Fusarium* species which could not be isolated from the material:—

- 1) *Ascochyta Cucumis* produces in the cucumber spots on the leaf, but no wilt;
- 2) *Fusarium sclerotioides* and *F. redolens* var. *angustius*, do not cause wilt, but, in certain cases, may give rise to a kind of stem-rot;
- 3) *Verticillium albo-atrum* is the only and the real specific agent of wilt; its hyphae easily enter the living tissues of both mature and young plants, and develop in large number in the vessels, which they stop up more or less completely.

Up to the present, apart from Ballersta, the disease has been reported from the districts of Stockholm, Nyköping, Västmanland and Örebro. Though the damage done is slight the possibility of further, more extensive infection, calls for a study of the methods of control.

The author suggests, in the first place, the uprooting and destruction diseased plants, care being taken to remove all the soil with which such ants may have been in contact. Dead plants left in the field rapidly become seats of infection. In infected districts neither cucumbers or potatoes should be grown for several years. The soil should be disinfected. The author believes that for this purpose good results could be obtained with formalin; tests with 2% potassium permanganate solutions had no effect.

7 - On "Verde-secco" of Fruit Trees in Apulia, Italy. -- VIVARELLI, I., in *La Prospettiva Agricola*, Series 2, Year X, No. 5, pp. 51-55. Bari, March 15, 1918.

In Apulia the name "verde-secco" is given to a serious disease by which many woody plants (almond, olive, apricot, myrobalan, and peach, etc.) pass with great rapidity from a state of normal and flourishing development to a very grave disorder followed by death. First the leaves yellow, then the smallest twigs, then the branches, and, finally, the trunk itself.

Field observations and experiments carried out by the author in different parts of Apulia (Andria, Canosa, Barletta, Casamassima, Trani, Mottola), showed no plant or insect parasites in the epigeal part of the plant, it proved the root system of all, or nearly all the plants killed by "verde-secco" to be attacked by a rot caused by *Rosellinia necatrix*. The disease favoured by certain conditions, such as heavy and impermeable soil, prolonged stagnation of rain water, badly executed plantation, the custom of digging, at the foot of the plant, a central hole to receive water instead of a circular ditch in proportion to the foliage, the re-planting of trees in the place of those recently killed by the rot.

According to the author, a plant the root system of which is seriously affected by the rot, has difficulty in maintaining the balance necessary to the complex working of its vegetative organs, and when by a sudden, high rise in temperature, especially during fine days, transpiration is considerable, cannot counterbalance it by an equal intensity of root absorption and dies. By allowing the plant to develop its root system well and to keep it healthy the damage described above would certainly be avoided.

8 - *Monilia* sp., the Cause of a Specific Gummosis of the Apricot Tree, in Italy. -- PEGLIONI, V., in *Rendiconti della Reale Accademia dei Lincei, Classe di Scienze fisiche, matematiche e naturali*, Series V, 1st. Half-Year 1917, Vol. XXVI, Pt. 12, pp. 637-641. Rome, 1917.

In Emilia apricot growing is seriously threatened by a form of gummosis which, already noted incidentally by BEIJERINCK and ERIKSSON, had been reported by FAES as very injurious to apricot trees in Valais, Switzerland, and by CHIFFLOT and MASSONNAT to those of the Rhone district (1).

The disease is caused by a conidial form (*Monilia*) of a *Sclerotinia* which, according to the author, would correspond to *Scl. laxa* if the differential characters observed by ADERHOLD and RUHLAND were sufficient to distinguish

(1) See B. Oct., 1915, No. 1098. (Ed.)

guish this parasite from *Scl. cinerea*. The most significant character is the absolute restriction of parasitism to the apricot tree, which is also observed in the Emilia orchards.

The first signs of infection occur during flowering; some of the flower fade and dry up, but do not drop. Later, when the leafy shoots are longer the wilt suddenly attacks, from one day to another, the buds corresponding to these flowers. Above the point of insertion of these buds sometimes at a distance of a few nodes, especially during rainy seasons a gummy stream of transparent drops is noticed flowing from the crack of the bark and forming lumps more or less large in size. A more considerable gummosis is observed on the adult branches and even on the trunk corresponding to a faded adventitious floral bud. The infection of the growing fruit is very limited; most frequently fruit is infected which has grown in contact with a mummified flower spotted with gum.

The rapid spread of infection which may occur seems to correspond to an early and rather long flowering period during which insects, by visiting infected flowers, carry conidia of *Monilia* and spread disease by visiting sound flowers.

This disease must be controlled by systematically destroying the parasite's hibernation quarters. It is not sufficient to burn the mummified fruit, which may easily be found and collected in winter; it is again the blisters formed by the fungus hibernating under the remains of flowers, on the twigs killed by the disease, and the fragments of bark covering the cankers of the adult branches and trunk that measures must be taken. It is easily suppressed by careful pruning when vegetation starts and the localised injuries on the tree can be seen without difficulty so that the tree may be cured before the winter period of rest. The cankers heal normally, and infection in them is limited to the more or less fragmentary remains of bark, which may easily be removed by superficial scraping.

599 - Treatment of *Fusicladium pirinum* var. *Eriobotryae*, Injurious to the Japanese Medlar Tree. - SAVASTANO, L., in R. Stazione sperimentale di Agronomia e Frutticoltura in Agraria, Bollettino, No. 25, pp. 6 + 2 Figs. Agraria, 1917.

In the east of Sicily a disease called " brusone " by the author, who has observed it for 8 years, is developing with increasing virulence on the branches, leaves and fruit of the Japanese medlar tree (*Eriobotrya japonica*). It is caused by *Fusicladium pirinum* (Lib.) Puck. var. *Eriobotryae* Scal.

On the medlars is observed a small, blackish spot, which gradually increases. The attack of the parasite may begin in December and continue till February or March.

If the fruit is attacked during the first stage of its development it becomes deformed, and shrivels, the spot grows, and the fruit dries up and becomes mummified. If attacked during ripening, this stage remains imperfect. The infected branches are twisted, stunted, spotted with black and with irregular, shrunken leaves; they fade and dry up from year to year.

[598-599]

Those trees which have the largest and sweetest fruit are most subject to attack by the fungus.

The author's experiments on winter treatment showed the efficaciousness of spraying with lime-sulphur mixture made according to the formula of the "Stazione di Agrumicoltura" (lime, 2 lb.; sulphur, 4 lb., water, 2 gall.). The mixture should be applied in 12 % strength, at the most 14 %, in December, when all the flowers have fallen, and in January.

The trees to be treated should be pruned in August, during the resting period, so as to remove the branches, in which the parasite passes the summer, and to give strength to the tree. The pruned branches should be burnt at once. It would be well to undertake experiments to prove whether 6 % sprayings in summer to destroy the parasite in the branches would be advisable.

600—The Tumours of the Cluster Pine (*Pinus Pinaster*), in France. — DU PREN OY, J., in *Comptes rendus des séances de l'Académie des Sciences*, Vol. CLXVI. No. 8 pp. 355-356 Paris, February 25, 1918.

The cluster pines of the Arcachon forests have many tumours on their stems and roots. On the one year stems the tumours are cankerous and exude abundant resin which flows down the stem. The old tumours may close and form lumps appearing as knots, more or less resinous on the surface.

After describing the structure of the tumours, the author draws attention to the masses of bacteria found in the diseased tissues. A very fine mycelium, which often lives on the surface of the resin exuded, may enter the cankerous tissues by the parts rendered resinous by the bacteria. This mycelium, however, is only an adventitious organism.

The author isolated the bacteria observed in the infected tissues. After 3 days at 12° C. when the tumours were one year old; and after 5 days when the tumours were older, cultures made with the tissues of the stem tumours develop very dense, greyish colonies, forming a slight veil over the surface of the agar, which they liquefy. The mycelium from the resin often grows in tubes at the end of 8 days, forming whitish colonies, quite distinct from those of the bacteria. At the end of 8 days cultures made with the tissues of the root tumours develop white colonies which become very dense and thick and grow on, or just below, the surface, without liquefying the agar.

Under the microscope the bacterial colonies from the stem appear to be composed of bacteria resembling those observed in the stem tumours. The colonies from the roots are composed of much larger bacteria than those from the stem and resemble those of the root tumours.

The stem and root tumours of *Pinus Pinaster* appear to be due to two different bacteria; the characters of which the author will publish later. The bacterial tumours of the stem of the cluster pine differ from those of the Aleppo pine which have long been known.

601 — *Phyllactinia suffulta*, an Ascomycete Injurious to Common Oak, in Spain

— ROBREDO, L. H., in *El Cultivador Moderno*, Year VIII, No. 3, p. 12. Barcelona, 1918.

For some time *Phyllactinia suffulta* has been spreading in the plantations of common oak in Galicia, depreciating the value of the tree for the various uses to which it is put.

As a preventative measure, to lessen the intensity of the disease during the following year, it is advisable to burn the infected fallen leaves in autumn, an operation which must be carried out simultaneously in all the neighbouring oak plantations. Sulphur treatment should also be carried out when the young shoots are about 4 inches long. This treatment should be carried out in dry weather and repeated 20 days or a month later if the white spots of the disease continue to appear on the leaves. The treatment costs about 2*d.* for an average sized tree and 4 ½ *d.* for a large tree.

Observations and experiments show that trees which are not pruned are not attacked by the fungus, that those pruned a little, are attacked slightly, and that those which are excessively pruned are badly attacked. *Quercus palustris* and *Q. rubra* var. *americana* are the varieties most resistant to the fungus.

INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

602 — Biological Observations on some Coleoptera of the Department of Hérault, France (1). — LICHTENSTEIN, J. L., in the *Bulletin de la Société entomologique de France*, No. 4, pp. 94-95. Paris, 1918.

Special mention should be made of :—

Anthaxia aurulenta Fabr. — An insect found on the elm, and, according to CAILLOL, especially on the small trunks of young, dead elms. Nevertheless in April the author found several specimens of this *Anthaxia* which seems very rare in the Department of Hérault, on young branches of *Salix alba*.

A. manca L. — Common on the elm and also known to occur on certain other trees, has not previously been reported on *Rhamnus Alaternus* (barren privet) on the branches of which the author found it in June and July.

Scobicia chevricri Villa. — Not rare on branches of fig trees, this insect is also a host of branches of vine and barren privet.

Stromatium fulvum Villers. — The author received from the province of Constantine, Algeria, branches of cork-oak containing larvae of this species which, in the Department of Hérault, develop on young elm. He obtained adult insects after 5 to 6 years (according to MAYET the larval stage may last for 15 years.) In some bits of branch, about 5 inches long, several larvae had developed, hollowing wide galleries throughout the sap-wood which were so filled with excreta that they were almost as hard as the wood. Although this insect is common in cork-oak forests, it does little damage.

Exocentrus punctipennis Muls. — In Languedoc its larvae are found under the bark of white willow and elm.

(1) See R. March, 1918, No. 366. (F&S)

Hylesinus vittatus Fabr. and *Scolytus multistriatus* Marsh. — These insects of young elms also attack branches of *Rhamnus Alaternus* L., following their galleries under the bark, where *Sc. multistriatus* is attacked by two braconidae — a species of *Ecphyllus* which will be described shortly, and *Dendrosoter protuberans*. *Hyl. vittatus* continually bears on its sides numerous mites not yet determined.

Rhytidoderes plicatus Oliv. — According to BEDEL this insect lives at the foot of *Reseda lutea*. It also seems to attack Cruciferae; the author found it eating a leaf of *Diplotaxis tenuifolia* in April, and another on cultivated cabbage.

Derolomus chamaeropsis Fabr. — Abundant on specimens of *Chamaerops humilis*, cultivated at Montpellier, particularly in the Botanical Garden, according to PERRIS the egg is doubtless laid in the ovaries, but the author has only observed this insect on the male flowers of the palm.

Chocorrhinus squalidus Fairm. — PERRIS reported it on elm and the fig-tree. The author found it in small numbers on the dead part of a fig-tree trunk which had been invaded by ants (*Cremastogaster scutellaris*); this insect is, however, by no means myrmecophagous; when it established itself in the trunk the ants had already left it.

Eremotes punctatulus Boh. — Dead ash wood, in which the author found larvae, pupae and adults, may serve as food to this insect which has already been observed on several species of trees.

Mononychus punctum-album Herbst. — It is very common at Montpellier on *Iris Pseudacorus* and *I. foetidissima*; the author knows, in rather moist soil, several of the latter, the fruit of which are eaten by the insect each year. He found large numbers of the *Mononychus* on different cultivated varieties of *I. germanica* and *I. florentina*.

— *Perezia legeri* n. sp., a Protozoan Parasite of the Larvae of the Large White Cabbage Moth (*Pieris brassicae*) (1). — PAILLOT, A. in *Comptes rendus des séances de la Société de Biologie*, Vol. LXXXI, No. 4, pp. 187-189 + 1 Fig. Paris 1918.

This paper describes a new microsporidium temporarily placed in the genus *Perezia* under the name of *P. legeri* n. sp.

It is found especially in the adipose tissue of the larva of *Pieris brassicae* and in some of the giant cells of its blood. In the rather rare cases of generalised infection the spores of the protozoon are found in all the tissues of the larva of the insect.

— *Leptocorisa varicornis*, a Weevil Injurious to Rice in Assam. — Report of the Agricultural Department, Assam, for the Year ending the 30th June, 1917, pp. 5. Shallog, 1917.

At Jaintia Perganas and the Karingary farm in Sylhet, *Leptocorisa varicornis* (rice bug) has done considerable damage to rice. The early varieties suffered most. The results of the experimental harvest showed the loss to amount to 90 % of the normal yield.

— Experiments on the Disinfection of Dwarf Beans Infested with *Acanthoscelides obtectus* and *Spermophagus subfasciatus*. — PANTANELLI, E., in *Le Stazioni sperimentali agrarie italiane*, Vol. I, Pt. 11-12, pp. 591-609. Modena, 1917.

Part of a consignment of dwarf beans imported from Brazil in May,

MEANS
OF PREVENTION
AND CONTROL

INSECTS, ETC.
INJURIOUS
TO VARIOUS
CROPS

1917, on arrival in Italy, was found to be already slightly infested with *Acanthoscelides obtectus* (1), and much more seriously by another weevil *Spermophagus subfasciatus* (= *Sperm. musculus*), peculiar to South America and hitherto met with only once in Europe (Paris), where it did not increase.

The author undertook experiments on the disinfection of the seed and the store-houses. He ascertained that to cause the certain death of the adult insects in the seeds, each hundredweight of dried beans should be treated for 48 hours with fumes given off by either 50 gm. of carbon bisulphide, by about 50 cc. of carbon tetrachloride (= 81.54 gm.) or by 0.5 gm. of potassium cyanide. The germinating power of the seeds is more affected by the bisulphide than by the tetrachloride, but is not affected at all by the potassium cyanide.

The store-houses may be satisfactorily disinfected by spraying with an emulsion of tar oil.

Among the preparations tested the author recommends "lysol" made by Schülke and Mayr, "cresosol" made by the Society for the distillation of tar (Società Distillerie Catrame), "creselion" made by Car Erba, and "creoline" prepared by G. Pearson.

Experiments made in October on *Ac. obtectus* and *Sperm. subfasciatus* at temperatures of from 12 to 15° C., showed that, to kill complete adult insects within the seeds the following proportions are needed:—

creoline	7 volumes in 100 volumes of water
creselion	6 " " "
cresosol	5 " " "
lysol	4 " " "

606 — Observations on *Acanthoscelides obtectus* (Bean Weevil), in Italy.

RAZZOTTI, A., in *Bollettino del Laboratorio di Zoologia generale e applicata della R. Scuola superiore d'Agricoltura in Portici*, Vol. XII, pp. 94-122 + 16 Figs. Portici, 1917.

Very little work has been done on the presence of *Acanthoscelides obtectus* Say ("tonchio del fagiolo") and the damage it does to runner and dwarf beans, although this insect has been known in the country for above 20 years. The present investigations were, therefore, undertaken in an attempt to learn more about the "bean weevil."

A list of the synonyms of the insect is followed by a morphological and biological description. According to some workers the insect is a native of Persia or Armenia, according to others of Northern America, and is so widely distributed geographically that it may almost be considered cosmopolitan. SHARP reports it from the following districts: — North America to the east of the Rocky Mountains, Mexico, Guatemala, Nicaragua, the Antilles, and the Argentine (Buenos-Aires). It is also found in Australia, the Azores Islands and the Canary Islands. In Europe, according to the author, *A. obtectus* is known in England, France and Italy. BERTOLINI reports it from the Alps, Maritimes and the Mediterranean district; MINÁ PALUMBO reports it from Genoa, Naples and from Sicily (Palermo, Castelbuono). According to inform

(1) See No. 605 of this Review. (Ed.)

received by the author, LUIGIONI found it in 1913 in the Valtournanche and SILVESTRI at Acerra (Caserta) and Lower Nocera (Salerno), where it did great damage to dwarf beans. In Tuscany the weevil is well known in the provinces of Florence, Leghorn, Lucca and Pisa, and the other provinces are not free. The large province of Pisa is particularly badly infested.

In the larval stage the insects prefer the seed of the numerous varieties of dwarf bean (*Phaseolus vulgaris*), and scarlet runner (*Ph. multiflorus*). In Tuscany the larger white varieties suffer most ("fagioli pisani" or "fagioli di S. Michele" or "premici") as well as elongated beans ("pinoli" or "piroli"); but the small varieties ("tondini") are less attacked.

In the absence of dwarf beans, however, the weevil may attack cow-pea (*Cajanus cajan*), bean (*Vicia Faba*), common vetch (*Vicia sativa*), the lupin (*Lupinus albus*), chickling-vetch (*Lathyrus sativus*), and garden pea (*Pisum sativum*). The author observed in artificial breeding that in exceptional cases the insect will adapt itself to maize.

A single bean seed may be attacked by 25 larvae in one generation, and several generations succeed each other very rapidly. The cotyledons become a mass of debris of no value as food. Even when infestation is slight the beans suffer heavily. It frequently happens that the beans cannot be sold and have to be thrown away or given to animals. In the province of Pisa and other districts the damage has been so heavy that some farmers have had to give up growing dwarf beans.

From a point of view of reproduction even, beans attacked by the weevil cannot be used as seed. An experiment carried out by the author in the spring of 1917 with dwarf beans gave the following results:—

Condition of dwarf beans	Number of beans sown	Number of beans germinated	Percentage of germination
Not attacked	50	42	84 %
1 generation	50	22	44 "
2 generations	50	24	48 "
3 "	50	10	20 "
4 "	50	3	6 "
5 "	50	0	0 "
Percentage of unattacked beans which germinated			84 %
Percentage of beans attacked by the weevil which germinated			23.6 %
Percentage of beans attacked by the weevil which were destroyed			76.4 %

Moreover, plants from seed attacked by the insect are much less resistant and subject to disease, besides giving a much lower yield of inferior quality.

A. oblectus has an efficacious enemy in the mite *Pediculoides ventriosus* (Newp.), but, to the author's knowledge, it has in Italy no natural enemy among the insects. The mite mostly attacks the newly-hatched

larvae, but may also attack adult larvae and pupae, although their surroundings make this more difficult. The eggs themselves are sought for by the mite, which eats their contents. It must, however, be pointed out that if the action of this *Pediculoides* is really useful, it may, during the transport and handling of infested seed, attach itself to the skin of those who manipulate the beans and cause more or less serious pathological trouble.

The artificial method of control most widely recommended in America is based on the use of bisulphide of carbon fumigations when the adults of the first and second generations appear, in the same manner and proportion as those required for wheat or other cereals. Another method, which the author found much more preferable for dwarf beans grown for food, is to put the beans attacked in an oven or drying room at a temperature about 60°C.

607 - *Hypothenemus ritchiei* n. sp., a New Scolytid Injurious to Dried Sweet Potatoes in Jamaica. — SAMPSON, WINN, in the *Bulletin of Entomological Research*, Vol. VIII, Pt. 3-4, p. 295. London, February, 1918.

The paper gives a morphological description of the scolytid *Hypothenemus ritchiei* n. sp., found by Mr. A. H. RITCHIE, Government Entomologist for Jamaica.

The beetle causes serious damage to dried sweet potato chips. It is not yet known whether it attacks other products.

608 - A New Weevil Pest of Sweet Potatoes in Jamaica. — MARSHALL, GUY, A. K., in *Bulletin of Entomological Research*, Vol. VIII, Pt. 3-4, pp. 260-272 + 1 Fig. London, February, 1918.

The Imperial Bureau of Entomology recently received from Mr. H. RITCHIE, Government Entomologist in Jamaica, specimens of a weevil which had caused serious injury to tubers of sweet potato. The insect, which belongs to the sub-family *Cryptorhynchinae* is a species new to science and is described under the name of *Palaeopus costicollis*.

According to Mr. RITCHIE the damage done by this weevil to sweet potatoes is similar to that done by *Euscepes batatae* Waterh., common in the West Indies and known there as "scarabee". As these two insects may easily be confused by untrained observers, Mr. RITCHIE considers it very probable that damage attributed to *E. batatae* has been caused by *P. costicollis*.

The author found in the British Museum two other specimens of the genus *Palaeopus*, one from St. Vincent and the other from Grenada. They are specifically distinct from the Jamaican species and from each other, and, as their habits are probably similar to those of *P. costicollis*, the author describes them in his paper under the names of *P. grenadensis* n. sp. (weevil from Grenada), and *P. subgranulatus* n. sp. (weevil from St. Vincent).

609 - Insect Parasites of the Cacao Tree and other Cultivated Plants in São Thomé. — DE SCABRA, A. F., in *Mémoires publiés par la Société portugaise des Sciences naturelles*, Vol. III, Pt. 1, pp. 1-28 + 24 Figs. + 1 Plate. Lisbon, 1917.

With the help of material obtained from various parts of São Thomé the author has collected in his paper a series of observations on the insects

parasites of cultivated plants in the island. The study pays particular attention to scale insects.

I. — A morphological description is given of a coccid which, with due reservation, the author identifies as *Aspidiotus trilobitiformis* Green. This species shows preference for cacao leaves, and is found ranged with great regularity along the main veins; the females are relatively rare on the upper surface, whereas, on the lower surface, the males are very rare.

According to information supplied by the director of the Perseverança farm, the damage caused by the insect is of less importance than that caused by certain cryptogamic diseases. The effect is first seen at the ends of the branches, which gradually dry up, so that, in two or three months, the plant loses all its leaves. Sometimes cutting the branches attacked prevents the development of the parasite, but this is not always the case and infestation spreads with great rapidity. The cut branches should be destroyed immediately near the tree.

The bailiff of the Bindá farm states that trees from four to six years old suffer most. The attacks of the coccid assume great importance on the Uba Budo farm; production there is almost nil.

Spraying with petroleum emulsion and other insecticides has been attempted, but its practical use is very difficult on account of the thick vegetation of the island which sometimes makes access to the plants impossible. Good results are hoped for from the propagation of fungoid parasites of the scale; experiments on this subject have already been made.

II. — The coccid *Lecanium viride* has been reported in the island, from specimens received from Perseverança farm, as a serious parasite of coffee; it is accompanied by its greatest natural enemy, *Cephalosporium Lecanii* Zimm. As this latter is fairly common in São Thomé, the author believes that, considering the very favourable climate, it would be easy to propagate it on a large scale. Experiments in the cultivation of this fungus have already been made in the island. The presence of this *Cephalosporium* may explain why a coffee plantation on the Perseverança farm which was severely attacked by the coccid in October, 1916, did not suffer serious damage. The fungus may be best disseminated by the method used in cotton, by which leaves bearing coccids attacked by the parasite are introduced into the plantations where *Cephalosporium* is non-existent or very rare; these leaves may be pinned on to those of plants to be protected against the attacks of the insect.

III. — A third note is confined to *Aspidiotus articulatus* Morgan and *Asp. palmarum* Morgan and Cockerell, neither of which occur in large numbers in the island but live at the expense of many wild and cultivated plants (coffee, *Ficus* sp.?, *Carica Papaya*). One of the wild plants particularly attacked by *Asp. articulatus* is an orchid, locally called "herba pega pega", which has been identified as *Megacelinium falcatum*.

Asp. palmarum is very abundant on the Uba Budo and Perseverança farms on *C. Papaya* and on *Ficus* sp.?. It is also found on many other native plants, but rarely on the cacao tree.

IV. — *Lecanium nigrum* Nictner is another parasite of coffee in the island, and is also very common on the large leaves of *Ficus* sp.? (Perseverança farm). The young larvae in particular are attacked by a fungus. The dimensions, shape and colour of this species vary; on the leaves attacked by it the author found a large number of specimens of *Asp. trilobiformis* and *Diaspis* sp.

V. — Among the most abundant parasites of coffee at São Thomé is the coccid *Orthezia insignis* (Douglas), which also attacks other plants. The author received from the Perseverança farm leaves completely covered with this insect which, according to the reports received, attacks in a general way the young buds, branches and stem, but seems to prefer the terminal bud of the plant. The coccid is found both on the upper and lower side of the leaf; sometimes it is found round the edge of the leaf. The branches attacked by the scale which were sent to the author for examination were found to be almost covered with a fungus (*Capnodium Coffeae* ?) the importance of which in São Thomé may be compared with that of *Capn. Citri* in Europe; the damage done when it attacks the young buds is well known. *O. insignis*, then, is a parasite dangerous, not only on account of the damage it does itself, but also because its secretions may form a favourable medium for the development of the fungus.

VI. — White ants are considered very injurious, especially in old cacao plantations. In a climate such as that of the island consideration must be given not only to the consequences to the plant itself of the galleries made by the ants, but also to the fact that the open galleries in the trunks, roots or even the soil, prepare the way for numerous cryptogamic diseases.

Through the research of Prof. E. SILVESTRI six species of white ants are known in São Thomé, and seven in Princes' Island. The first specimens sent from São Thomé and examined by the author belonged to *Neotermes gestri* F. Silvestri, known locally as "Salalé"; numerous specimens of this species were sent from Binda in June, 1916. Another variety from the same locality, of which only very few specimens were received belonged to the s. sp. *theobromae* Dens. of *Microcerotermes parvus* Hav. It is known in the island by the name of "formiga branca". *N. gestri* is one of the greatest pests of the cacao plantations at Uba Budo. The infested plants are said to revive if cut at the base so long as they are not attacked by disease. At S. João dos Angolares, *N. gestri* also attacks old plantations, entering the trunks by badly closed pruning cuts.

In August, 1916, the author received the first notice of damage done by *N. gestri* as being of great importance in the occurrence of cryptogamic diseases. The old plants suffered most, especially those with broken branches which had not been carefully treated with protective substances. According to the author the insect always enters the trunks in the upper part, but the nests are always underground. The bailif of the Binda farm also observed that the insect enters the trunk in the upper part and shows a tendency to descend, never to ascend the branches. This observation may be of value in controlling the pest.

610 - **The Most Common Deformities Caused by Animals on Fruit Trees in Sicily.**—DE-STEFANI, T., in *Annali della R. Stazione di Agricoltura e Frutticoltura, Acireale*, Vol. IV, pp. 147-170 + 1 Plate. Acireale, 1917.

The aim of the paper under review is to draw attention to the numerous and complex deformities of animal origin of which horticulturists have more the cause. Insects and other invertebrates (arachnida, worms) are the causes of these deformities. They belong chiefly to the hemiptera, and, especially, to the aphids, and, in decreasing order of importance, to the diptera, with the family of *Cecidomyiidae*, the lepidoptera, with 4 representatives, the coleoptera, with 2, the hymenoptera and neuroptera, with only one representative. The greater part of the species causing deformities on fruit trees, however, belong to the arachnida, especially the mites, which form the family of *Eriophyidae* and certain species of nematodes, belonging to the family of *anguillulidae*.

In order to draw up a guide by which tree growers may recognise deformities caused by animals, the author gives a brief morphological descriptions of such injuries most common in Sicily, together with an indication of the specific agent.

1 - ***Olethreutes variegana*, a Microlepidopteron Injurious to Fruit Trees, in Italy.**—SARRA, A., in the *Bollettino del Laboratorio di Zoologia generale e agraria della R. Scuola superiore d'Agricoltura in Portici*, Vol. XII, pp. 175-187. Portici, 1918.

The species described exists in central and southern Europe, Livonia, inland, Sweden, and Asia Minor. A morphological description is given of the egg, larva, and pupa, followed by the biology of the perfect insect and the larva.

In the districts of Santeramo Colle (Apulia) and Matera (Basilicata), the larva lives on the common medlar, almond, mahaleb cherry, plum, apricot, and apple trees. The author found it from March 15 to April 30. Medlar and plum trees are attacked the most. Other host-plants are: *Prunus avium* L., *P. Cerasus* L., *P. insititia* L., *Pyrus communis* L.

The parts of the medlar which suffer most are the leaves, the floral buds, and the small fruit, which is covered with holes or entirely destroyed. In the plum, apple, apricot and mahaleb cherry trees, only the leaves are attacked. The leaves of the almond are attacked, and sometimes, though rarely, the young fruit, which is pierced and filled with the remains of the exuviae. Experiments have shown that a larva fed on almond leaves will eat almost two whole ones in three days so that it may do a fair amount of damage to a medium sized tree. In the company of other tortricids, however, and especially if low trees, such as the medlar, are attacked, the injury done by *O. variegana* may be very serious.

According to the author the insect is controlled by five parasitic hymenoptera — the chalcid *Copidosoma* sp., the braconid *Acrogaster quadridentatus* Wesm., *Apanteles longicaudis* Wesm., *Macrocentrus thoracicus* Nees, and the ichneumonid *Pristomerus vulnerator* (Pauz.) Curtis.

The chalcidid lays an egg in that of *O. variegana*; the author noticed that 4 % of the larvae of the microlepidopteron contained parasites.

A. quadridentatus lays its egg in the larva of the tortricid, and was found in 20 % of them. *Ap. longicaudis* also lays an egg in the larva of *O. variegana*.

gana, being found in 6 %. The larva of *M. thoracicus* is an endophagous parasite of the larva of the microlepidopteron; the specimens of the braconid examined by the author represented 1 % of the larvae of *O. variegans*. *Pr. vulnerator*, the larva of which is also an endophagous parasite of the larva of the tortricid, was observed in 4 % of the latter.

When it is easy to collect the larvae the natural method of controlling *O. variegans* is to be recommended, and should be carried out in April. The larvae are enclosed and bred in boxes placed in the open, and covered with a wire netting with a mesh not exceeding 2 mm., so that the parasite may pass, but not the adult microlepidoptera. When artificial control is necessary spraying with 1 % lead arsenate paste or 1/2 % lead arsenate powder may be recommended.

612 — **The Campaign against the Codlin Moth (*Carpocapsa pomonella*) in Cyprus, in 1917.** — *The Cyprus Agricultural Journal*, Vol. XIII, Pt. 1, p. 13. Nicosia, 1917.

In accordance with His Excellency's Order of April 25, 1917, a campaign was started in 1917 in Cyprus, against the codlin moth, which, for some time had caused much injury to apple, pear, quince and walnut trees. The operations included some 26 villages in the Pitsillia of which Agros was the centre.

The treatments applied were:—a) lime-dressing; b) daily collection and destruction of fallen fruit; c) bandaging the trunks with grass or cloth bands.

The application of grass bands was not very successful. As many as 80 000 trees were lime dressed.

613 — **Strong Lime-Sulphur Spraying against *Chrysomphalus dictyosperma* a Coccid Injurious to Citrus.** — SAVASTANO, L., in *R. Stazione sperimentale di Agricoltura e Frutticoltura in Acireale*, Bollettino No. 30, pp. 3. Acireale, 1917.

Without modifying in any way the formula of the lime-sulphur mixture used by the "R. Stazione di Agrumicoltura e Frutticoltura" of Acireale (lime, 2 lb.; sulphur, 4 lb.; water, 2 gall.) attempts were made to ascertain whether it were possible to increase the insecticidal power of the dilution, i. e., the percentage, in order to obtain a greater and more rapid effect against the scale *Chrysomphalus dictyospermi* ("bianca-rossa" of citrus).

The results obtained from the various experiments carried out under the supervision of the author may be summarised as follows:—

- 1) The trees may be sprayed in September and at the beginning of October with a 10 % mixture, density 1.25, to obtain better results.
- 2) 10 % must not be exceeded as the plant may be scorched;
- 3) the spraying must be even and very fine but not very abundant as, if so, even in percentages below 10, it may cause scorching;
- 4) the percentage may be raised to 12 % when the *Chrysomphalus* attack is severe, and when the fruits are few, completely infected, and valueless.

Strong treatment is advantageous in the case of bad attacks or when spraying at the correct time has been neglected. Orange trees not yet in fruit of which would lose all value if scorched — should, however, only be treated if infection is so serious that it is the tree itself which must be saved. As a general rule it may be said that only lemon trees should be

eated; the fruit which is thrown out might be used for obtaining essence of citrate, as lemons when slightly scorched are in no way spoilt for the extraction of these two products.

14 — **Observations on *Coeliodes ruber*, a Coleopteron Injurious to Hazel Trees in Italy.** — SILVESTRI, F., in *Bollettino del Laboratorio di Zoologia generale e agraria della R. Scuola superiore d'Agricoltura in Portici*, Vol. XII, pp. 155-174 + 14 Figs. Portici, 1917.

Before 1904 the damage done to hazel trees by the coleopteron *Coeliodes ruber* (Marsh) had not been studied. In that year TROTTER drew attention to the injury done to the male inflorescences of the tree by the larvae of this insect. The question was not taken up again till 1914, when great loss of nuts was reported at Vico di Palma, Campania (province of Caserta) though the attacks of *C. ruber*. The author, therefore, undertook a study of the insect, and, during the last three years, continued his studies not only in the Nola district, but also in the Avellino district.

After giving a detailed morphological and biological description of the insect the author points out that *C. ruber*, which is only known to attack hazel trees, is shown by the catalogues of coleoptera to exist throughout Europe. In Italy the author found it frequently in the districts of Avellino and Nola, as well as round Naples, he has also seen specimens from Capri and found a few in Sicily (S. Piero Patti).

The adults attack the leaves, piercing holes in the blade or in the petiole. They also attack the buds by hollowing a hole in the axis, a few centimetres from the point, the nuts, by piercing the shell and part of the kernel, which they eat, the catkins, by piercing them and eating some of the flowers; they may also attack the floral and leaf buds. The attacks result in the drying up of the pierced leaves, buds and young nuts, and the destruction of some of the flowers of the catkin. The larvae also destroy some of the male flowers.

The most serious damage caused by the adults and larvae would appear to be that done to the petiole and the axis of the buds. In reality, however, if this damage is compared with the number of insects found in recent years and the number of leaves and buds on a plant, it may be considered negligible. This also applies to the damage to the catkin, for, since the catkin is not entirely destroyed, there remains a plentiful supply of pollen. If, contrary to the author's observation, the greater part of the catkins were destroyed, atrophy of the female flowers through lack of fertilisation, such as TROTTER feared, might be expected.

The worst damage by *C. ruber* observed by the author and complained of by growers from 1914 to 1917, is that done to the young nuts which, if pierced by the insect once only, immediately dry up. Such injury has been frequently observed in the Nola district, where the S. Giovanni, an early variety, the fruit of which, at the end of May, is already 5 mm. long and 7 mm. broad is the most common variety of hazel.

In field observations the author frequently saw spiders of the family Thomisidae, *Xisticus lanio* C. Koch, capture adult *Coeliodes* for food. Others also probably attack the insect, but, judging by the number of *C. ruber* on the trees, their action does not appear to be very efficacious.

From 1914 to 1917 the author observed numerous eggs, larvae and

pupae of *C. ruber*, but only noticed one parasitic hymenopteron (family *Ichneumonidae*) which laid its eggs in the larvae which was later eaten by the insect hatched from the egg while it was underground in the cell in which its metamorphosis should have taken place. The author calls the new hymenopteron *Thersilochus coeliodicola*.

The only efficacious and practical artificial method of control is the collection of the adult insects during the first fortnight in May. This should be done in the morning by means of a cloth stretched under the plant, the branches of which are shaken by hand or with hooked sticks. By this means are destroyed at the same time many nut weevils (*Balaninus nucum* [L.]) another curculionid which occurs on hazel trees at the same period and often does great damage by attacking the nuts. If *C. ruber* is not collected in May it should be collected at the end of September or the beginning of October.

615 - *Coleophora fuscadinella*, a Microlepidopteron Injurious to Birch and other Trees in Sweden. — KEMMER, N. A., in *Kungl. Landbruks Akademiens Handlingar och Tidskrift*, Year LVII, No. 7-8, pp. 637-660 + 30 Figs. + Bibliography of Publications. Stockholm, 1917.

In 1914 the conditions in Sweden were very favourable to the development of *Coleophora fuscadinella* Zell. ("Björksäckmalen") the numerous larvae of which, in 1915 and 1916, caused considerable damage to birch trees by attacking their foliage. Other trees besides birch were attacked — pear trees, apple trees, *Sorbus Aucuparia*, oaks, etc. — with such violence that at times the whole tree, or a greater part of it, dried up.

The districts which suffered most were those of Östergötland, Jönköping, Kronoberg, and Kalmar, whereas in the Malmöhus district the attacks were very limited, probably because there are few birch trees there. More or less wide-spread attacks were also reported from the districts of Älvsborg (Vänersborg), Örebro (Bofors), Sörmlands (Stenstorp), Kopparberg (Falun), and Norrbotten (Luleå). Copulation and oviposition occur towards the end of June and the beginning of July. The larvae hatch after about a fortnight and live on the leaves, eating the tissues. They hibernate on the branches of the host (near the buds) in a shelter made of bits of leaf joined by silky threads. Hibernation ends in May, and it is in this month and in June that the adult larva, before pupating, does the greatest damage.

In 1917 the pest was decreasing rapidly, certainly largely on account of the many natural enemies of the insect which have been reported in various parts of Sweden. Amongst them are: — *Hemiteles* sp. ♂; *Itoplectis maculata* F. ♂ and ♀; *Glypta* sp. ♂; *Phobocampa* sp. ♂; *Agathis varipes* Th.; *Apanteles sodalis* (?) Hall.; *Apanteles* sp.; *Pezomachus instabilis* Först.; *Angitia* sp.; *Apanteles corvinus* Reinh.; *A. xanthostigmus* Hal.; *A. mesoxanthus* Ruschka n. sp.; *Microdus mediator* Nees; *Habrocytus radiatus* Thoms.; *Dibrachys bonheanus* Ratz.; *Elasmus viridiceps* Th.; *Cirrospilus pictus* Nees; *Miotropis sulcicrista* Th.; *Chrysocharis elongata* Th.; *Gemcerus charoba* (Walk). Kurdistan.

A. mesoxanthus n. sp. was reported from Lambult (Kronoberg) and from Luleå.

[614-615]

ALFREDO RUGGERI, gerente responsabile.

In quoting articles, please mention this REVIEW.

CONTENTS

ABSTRACTS.

AGRICULTURAL INTELLIGENCE.

I. — GENERAL INFORMATION.

GENERAL HYGIENE. — 616. The Nutritive Value of Yeast, Polished Rice and White Bread as Determined by Experiments on Man. — 617. The Digestion of Aleurone Cells Incorporated in 85 % Bread: Experiments in France. — 618. Physiological and Pharmacological Studies on Coal Tar Colours. Experiments with Fat-Soluble Dyes. — 619. Copper in Certain White Wines, in Chocolate and in Beans.
EXPERIMENTAL AND ANALYTICAL WORK. — 620. Report on the Agricultural Control Stations of Holland for the Year 1916-1917.

II. — CROPS AND CULTIVATION.

a) GENERAL.

AGRICULTURAL METEOROLOGY. — 621. Method for Calculating the Length of the Growing Season at any Period of the Year and in any Locality. — 622. The Relation of Weather to the Amount of Cotton Ginned during Certain Phases of the Harvest.
AGRICULTURAL PHYSICS, CHEMISTRY AND MICROBIOLOGY. — 623. Researches on Certain "Soil Sickneses" in the Netherlands. — 624. Studies on Nitrification in Natural Soils and Its Importance from an Ecological Point of View, in Sweden.
PERMANENT IMPROVEMENT, DRAINAGE AND IRRIGATION. — 625. Irrigation of Rice in California.
MANURES AND MANURING. — 626. On Green Manures. — 627. Fertilizers in South Africa.

b) SPECIAL.

AGRICULTURAL BOTANY, CHEMISTRY AND PHYSIOLOGY OF PLANTS. — 628. Plants Imported into the United States by the Bureau of Plant Industry of the Department of Agriculture during the Half-Year July 1 to December 31, 1917. — 629. The Separation of Autogenous and Added Hydrocyanic Acid from Certain Plant Tissues and its Disappearance during Maceration. — 630. The Direct Influence on the Stock of the Sap produced by the Scion, and the Action on the Plant of Acid Solutions Absorbed Directly. Experiments in Italy. — 631. The Influence of Acids on Germination. — 632. Some Effects of Organic Growth Promoting Substances (Auxinones). — 633. Translocation of Seed Protein Reserves in the Growing Maize Seedling.
PLANT BREEDING. — 634. The Origin of "Humpback" Wheat by Selection. — 635. Two New Varieties of Field Pea Obtained by Pure Line Selection, in Norway. — 636. Maternal Influence.
INTERNAT. INST. OF AGRIC. *Internat. Review of Science and Practice of Agriculture*, Year IX, No. VI. Rome, June, 1918.

- heritance in the Soy Bean. — 637. Hybridisation Experiments between Different Varieties of the Cultivated and Wild Strawberry, in Alaska, U. S. A. — 638. Acclimation, Selection and Hybridisation Experiments with Fruit Trees in Alaska, U. S. A.
- AGRICULTURAL SEEDS. — 639. The Germination and Purity of Seeds in Alaska.
- CEREAL AND PULSE CROPS. — 640. Study on Two Spring Wheats: "Aurora" and "Big Allis". — 641. Marquis Wheat. — 642. The Origin, Characteristics and Quality of Humpback Wheat.
- PLANTS YIELDING TANNIN. — 643. Plants Yielding Tannin, in India.
- RUBBER, GUM AND RESIN PLANTS. — 644. Venezuelan Production of Balata.
- SUGAR CROPS. — 645. The Nature of the Soil and Manuring as Factors Determining the Tendency of Beets to Bolt (Set Seed) the First Year. — 646. Experiments on the Cultivation of Sugar Beet in Sicily.
- HORTICULTURE. — 647. Varieties of Strawberry and their Culture in Indiana, U. S. A. — 648. Varieties and Cultivation of Raspberries, Blackberries, Gooseberries and Currants in Indiana, U. S. A.
- FRUIT GROWING. — 649. The Common Honey Bee as an Agent in Plum Pollination. — 650. The Selection and Acclimatisation of Fruit Trees in Alaska, U. S. A.
- VINE GROWING. — 651. Grafting Stock in Sicily: The Experimental and Demonstrative Vineyards Attached to the Royal Nursery of American Vines at Marsala.
- FORESTRY. — 652. Humification and Nitrification in Forest Soils.

III. — LIVE STOCK AND BREEDING.

a) GENERAL.

- HYGIENE. — 653. Studies in Forage Poisoning. — 654. The Toxic Action of *Thlaspi altissimum* and the Active Principles of Some Poisonous or Suspected Cruciferae. — 655. Researches on the Malady "Trembles" or "Milk Sickness", caused by *Eupatorium ageroides* in North Carolina, U. S. A. — 656. Investigations on the Etiology and Control of Infectious Abortion in Mares, in Kentucky, U. S. A.
- FEEDS AND FEEDING. — 657. The Amino-Acid Minimum for Maintenance and Growth, as Exemplified by Further Experiments with Lysine and Tryptophane. — 658. Influence of the Amino-Acid Content of the Diet on the Growth of Chickens. — 659. Studies on the Nutritive Deficiencies of Wheat and Grain Mixtures and the Pathological Conditions produced in Swine by their Use. — 660. The Stability of the Growth Promoting Substance in Butter-Fat. — 661. A Vitamine Favouring Growth, Isolated from the Pancreas of the Sheep. — 662. The Nature of the Dietary Deficiencies of the Wheat Embryo. — 663. Studies of Cotton-seed as Food. — 664. Test of Three Protein Concentrates and Two Lysinous Roughages in Milk Production. — 665. Feeding with Maize Silage and Grated Cotton Cake: Its Influence on the Composition and Quality of the Butter.

b) SPECIAL.

- CATTLE. — 666. The Role of Water in a Dairy Cow's Ration; Investigations made in U. S. A. — 667. The Influence of Parturition on the Composition and Properties of the Milk and Milk Fat of the Cow. — 668. Winter Steer Feeding in Indiana, U. S. A.
- SHEEP. — 669. Fattening Western Lambs in U. S. A.

KEEPING. — 670. The Wintering of Bees in Ontario, Canada. — 671. Bottini, Colantoni, "Subalpina" and "Sughera" Bee Hives. — 672. The Common Honey Bee as an Agent in Plum Pollination.

RE CULTURE. — 673. Can the Action of Cold Decrease Mortality among Silkworms Suffering from "Flacherie"? — 674. On the Discovery of a Plant Suitable for Feeding Silkworms.

— 675. Production of Silkworm Eggs of the Annual Breed, in Japan in 1917. — 676. Development of the Silkworm Industry in Cambodia.

SE CULTURE. — 677. The Raising of Leather-Carp and Black-Bass in Sologne, France.

IV. — FARM ENGINEERING.

AGRICULTURAL MACHINERY AND IMPLEMENTS. — 678. British Agricultural Tractors. — 679. Ploughing with Government Tractors in England. — 680. The Use of Coal Gas for Ploughing Tractors. — 681. Ridger for Making Irrigation Levees. — 682. Review of Patents.

V. — RURAL ECONOMICS.

Organization of Ten Dairy Farms in the Bluegrass Region of Kentucky.

VI. — AGRICULTURAL INDUSTRIES.

INDUSTRIES DEPENDING ON PLANT PRODUCTS. — 684. Wine Making with Foxy Grapes. — 685. Cupreous White Wines with Extreme Delayed Thickening. — 686. The Mycodermis of Wine. — 687. Cement Vats. — 688. A Method for the Separation of Protein from Non-Protein Nitrogen in Wheat Flour. — 689. The Milling Value of the Wheats "Aurore" and "Blé des Alliés". — 690. Milling and Bread-Making Tests with Humpback Wheat, in the U. S. A. — 691. A Comparison of Linseed Oil and Lumbang Oils as Paint Vehicles. — 692. The Use of *Bacillus falsarius* in Retting Various Textile Plants.

INDUSTRIES DEPENDING ON ANIMAL PRODUCTS. — 693. The Proteins of Cow's Milk. — 694. On the Thermo-Resistance of Non-Sporogenous Bacteria in Milk. — 695. New Contribution to the Commercial Sterilisation of Milk. — 696. The Composition and Market Qualities of Butter when Corn Silage is Fed with Cottonseed Meal. — 697. The Determination of Fat in Certain Milk Products. — 698. Wool Studies: Washing Sheep Before Shearing; Time of Shearing. — 699. The Indian Hide and Leather Trade.

AGRICULTURAL PRODUCTS: PRESERVING, PACKING, TRANSPORT, TRADE. — 700. The Refrigeration Plant of Lyndiane, Senegal. — 701. Enzyme Activity at the Temperature Maintained in Cold Stores. — 702. Preserving Fish without Ice. — 703. The Supply of Canned Salmon in the United States.

PLANT DISEASES.

III. — DISEASES DUE TO FUNGI, BACTERIA AND OTHER

LOWER PLANTS.

GENERAL. — 704. Myxomycetes and Fungi of Ceylon. — 705. New Japanese Fungi. — 706. Fungi of the Philippine Islands.

RESISTANT PLANTS. — 707. The Resistance of Plants to Diseases and Pests, in Relation to the Acidity of the Sap.

MEANS OF PREVENTION AND CONTROL. — 708. Patents for the Control of Diseases and Pests of Plants.

DISEASES OF VARIOUS CROPS. — 709. Principal Diseases of Vegetables, in Ontario, Canada — 710. Lettuce Drop, Caused by *Sclerotium Libertiana*, in Florida, U. S. A. — 711. Observations on the Parasitism of the Ascomycete, *Ustilina vulgaris*, in France.

IV. — WEEDS AND PARASITIC FLOWERING PLANTS.

712. The Worst Weeds in Cereal Crops, in Indiana, U. S. A. — 713. The Destruction of Weeds by Sodium Bisulphate.

V. — INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

GENERAL. — 714. Hymenoptera Parasitic on Injurious Insects, in Southern Brazil.

INSECTS, ETC., INJURIOUS TO VARIOUS CROPS. — 715. *Dictyothrips aegypticus*, a Thysanopteron Injurious to the "Black Morocco" Variety of Vine, in Cyrenaica. — 716. *Lonchaea angulata*, a Dipteran Injurious to the Fig Tree and the Wild Fig Tree in Italy. — 717. *Corythucha spinulosa* Gibson, a New Lace-bug on Wild Cherry, in New Jersey. — 718. Insects Injurious to Forest Trees in Sweden, in 1916.

The Bureau assumes no responsibility with regard to the opinions and the results of experiment outlined in this Review.

The Editor's notes are marked (Ed.).